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ADVANCED
TECHNOLOGY
LABORATORIES

BIBLIOGRAPHY OF OPEN LITERATURE ON SEALS

BY

R.L. GEORGE
R.C. ELWELL

REPORT NO. 63GL102

JULY 2, 1963

GENERAL ELECTRIC

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This is the fourth volume of a report describing various technical efforts applied under contract NAS 7-102, during the period Feb. 26, 1962 to Feb. 25, 1963.

This volume consists of a bibliography of 1482 abstracts of documents available in the open literature.

A complete subject index is included.

KEY WORDS seals, sealing, bibliography, materials, static seals, dynamic seals

INFORMATION PREPARED FOR Missile and Space Division

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ACKNOWLEDGEMENT

Even more than in the case of the previous volume in this report, this document is the result of the efforts and cooperation of many people.

Most of the abstracts were prepared by the General Electric Company Main Library in Schenectady, New York, under the direction of Miss Esther S. Kalis. Direct supervision of the preparation of the abstracts was performed by William J. Leahy. He was assisted by Farrell D. Madden, Fay W. Secor, and Chester P. Kulesza.

As in the previous volume of ASTIA literature, Mr. John P. Laniewski categorized most of the references for their technical content, and his judgement served as the basis for construction of the Subject Index.

The important tasks of keypunching, machine searching, and listing of the abstracts for the Subject Index was accomplished by Mrs. Jessie Dockstader and Miss Doris Filkins.

Assistance in final preparation of this volume was given by the Schenectady General Electric Typing Bureau, Mr. Ray Ardizzone, Miss Kathleen Hay, Miss Carole Madden, Mr. Howard Robison, Mrs. Mildred Melideo, Mrs. Ismeine DuPont, Mr. Robert S. White, and Miss Lillian Giavonnangelo.

To all of the above, and the others who helped in still other ways, we would like to express our appreciation for the courtesy and cooperation we consistently received in the accomplishment of this project.

R. L. George
R. C. Elwell

INTRODUCTION

This is the second part of a bibliography on seals and sealing, prepared by the Advanced Technology Laboratories (formerly the General Engineering Laboratory) of the General Electric Company, under NASA Contract NAS 7-102.

The first part of the bibliography, which constitutes Volume 3A of this Final Report, was composed of 682 abstracts of literature available from the Armed Services Technical Information Agency (ASTIA). This part, Volume 3B, presents 1482 additional abstracts available from the open literature.

The literature search which culminated in the issuance of this volume was carried out by the General Electric Company Main Library in Schenectady, New York. Shortly after commencement of this search, two major bibliographies on the subject became available. These documents are as follows:

1. "Bibliography on Dynamic Shaft Seals, Preliminary Issue," W. K. Stair, University of Tennessee, Engineering Experiment Station, May 1962, 97 pages, 353 references, Prepared under Subcontract Number 2118 for Union Carbide Nuclear Company

2. "Bibliography on Fluid Sealing," BIB-1, A. L. King, British Hydromechanics Research Association, South Road, Temple Fields, Harlow, Essex, England, May, 1962, 38 pages, 373 references, Price: 20 shillings

Because of the excellent preparation of the abstracts in these two publications, we have repeated many of them in this volume with the approval of the issuing agencies of these documents. Abstracts repeated from the University of Tennessee Bibliography are identified by a letter "T" in the upper right corner, and items repeated from the BHRA bibliography are likewise identified by a letter "B". Examples are references A-142 and A-144 on page 11.

The majority of the abstracts contained herein, however, were prepared by the General Electric Main Library in the period of April-December, 1962. The sources searched were as follows:

Aeronautical Engineering Index	1947 - 1957
Aerospace Engineering Index	1958
Aerospace Engineering-Review & International Aeronautical Abstracts	1959 - 1960
Applied Science & Technology Index	1958 - Nov. 1962
ASM Review of Metal Literature	1944 - Feb. 1962
Battelle Technical Review Abstracts	1952 - Nov. 1962
British Hydromechanics Research Association Bibliography on Fluid Sealing, May 1962, 444 references, 38 pp.	
Chemical Abstracts	1907 - 1961
Engineering Index	1884 - Nov. 1962
Index of NACA Technical Publications	1915 - Sept. 1958
Index of NASA Technical Publications	Oct. 1958 - Dec. 1961
Industrial Arts Index	1914 - 1957
International Aerospace Abstracts	1961 - Aug. 1962
NASA Technical Publication Announcements	Jan. - Oct. 11, 1962
National Conference of Industrial Hydraulics	1947 - 1961
Nuclear Science Abstracts	July 1948 - July 31, 1962
Science Abstracts (A) (Physics)	1898 - Oct. 1962
Science Abstracts (B) (Electrical Engineering)	1898 - Oct. 1962
Technical Translations	1959 - Sept. 15, 1962
Translation Monthly	1955 - 1958
U. S. Government Research Reports	1946 - Sept. 20, 1962
University of Tennessee, Engineering Experimental Station, Bibliography on Dynamic Shaft Seals, W. K. Stair, May 1962, 353 references, 97 pp. Includes references through Dec. 1961.	
Vacuum Abstracts	1951 - July/Aug, 1962

Although it may not be apparent from the dates shown, each source was searched back to its beginning, in the interest of completeness.

The complete process in the production of this publication was as follows:

a. the sources above were searched for pertinent references

b. abstracts were prepared of articles which had potential value

c. each abstract was studied and its content coded in terms of a ten-digit code. For instance, the number 01-13-47-63-83 would describe a reference about installation of bronze labyrinth seals in steam or gas turbines. There were 2,414,720 possible code numbers of this type in the system

d. a serial number was assigned to each item, consisting of a letter followed by a number. The letter was the first letter in the primary author's name, and the number was the serial number within that alphabetical group. These identification numbers are used in the test and Subject Index.

e. an IBM card was punched for each code number for each reference, up to a maximum of 20. (Most abstracts had multiple codings because of multiple types of technical content). A total of approximately 9000 cards were required for the open literature abstracts.

f. While the text was being type-written (using IBM "Charter" type to save space), the IBM deck was searched for preparation of the Subject Index. For instance, to list all references on Bushings (see page 147), the deck was sent through a keysorting machine set for the number 1 in Column 8 of the card and the number 4 in Column 9. This task obviously could also be done manually, but because of the extensiveness of the Subject Index, a great deal more labor would have

been required.

g. The final step was to duplicate the document.

We have intended in this search to abstract every English language document that it was feasible and worthwhile to obtain. This was mainly so that the task would never have to be done again. With a scope of this magnitude, errors and omissions are unavoidable. The authors would greatly appreciate being informed of these so that a potential second edition of this document would be of even greater value in the saving of future technical manpower.

A-001
Abbott, H.M.
Space Environmental Effects on Seals, Gaskets, Adhesives and Other Elastomeric and Polymeric Materials
Lockheed Aircraft Corp., Missiles and Space Div., Sunnyvale, Calif., NP-11194, 220 pp., Contract AF04(647)-673., Sept., 1961

This bibliography contains 558 selected references on seals, gaskets, adhesives, sealants, and other elastomeric and polymeric materials under space conditions. These references were compiled for the years 1951-1961. A material index is included as a possible aid in locating specific materials.

A-002
Adam, H.
Theoretical Principles of Compressive Glass Seals and Their Practical Results
Feinwerktechnik 56, No. 2, pp. 29-40, 1952
Spec. Lib. Assn. Trans. 57-2748 (53 pp.)
(Loan copy only)

A-003
Adam, H.
Compressed-glass Seals. Principles, Manufacture and Technical Applications
Glas-und Hochvaknum.-Tech. No. 7, pp. 123-34, 1952. Spec. Lib. Assn. Trans. 57-2757 (27 pp.)
(Loan copy only)

A-004
Adam, H.A., Kaufman, S.
Indium Seals for Dismountable Vacuum Systems
Journal Sci. Instrum., V. 341, pp. 123-124, March, 1957

The present investigation was required to produce a metal seal for applications where no external clamping was possible and compression of the seal was due solely to atmospheric pressure. Details of preparation, procedure, and use are described. Various sizes are checked. Leak rates against surfaces of various materials given.

A-005
Adilletta, J.G.
How to Apply O-Rings
Product Engineering, V. 28, pp. 176-182, Aug., 1957

Test program develops simplified principles for proportioning mechanical parts to achieve maximum sealing at minimum cost. Type of sealing required dictates seal choice.
Effect of factors such as fluid pressure, surface finish, and eccentricity of shaft and cylinder on initial "squeeze," cross-section rind diameter, and Durometer of rubber.

A-006
Adloff, K.
Creep of Flanged Joints
Warme, V. 58, pp. 352-355, June 1, and pp. 387-389, June 15, 1935

The calculations by different methods of the stresses in the tube and flange material and in the connecting bolts, both for solid and loose ring flanges is compared. In order to insure a tight joint under pressure, the initial load on the bolts should be at least equal to twice the load due to the steam pressure. It is an advantage to heat the bolts when the flange joint is being erected. The effect of the creep is to reduce the stress in the bolts. The determination of a time factor for estimating the life of a flanged joint under steady creep is considered.

A-007
Admire, B.W. and Mayor, F.S.
A Gas Shaft Seal For The HNPE Sodium Pump
Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif., NAA-SR-MEMO-2616, June 30, 1958, (6 pp.)

Lip type, oil labyrinth gas shaft seals were tested for use on Hallam power reactor sodium pumps with a 5 inch diameter rotating shaft. The seals were not recommended for use owing to excess helium leakage and short life.

A-008
Aitchison, T.C., and Bowers, B.N.
Nitrile Rubber Gaskets Make Better Seals
G-E Review, V. 55, pp. 46-50, May, 1952

Characteristics of nitrile rubber makes it an almost ideal gasket material for sealing the joints of liquid-filled electrical apparatus against oil and non-inflammable insulating liquids such as askarel, air, and moisture, for reasons listed. Radical changes were made in previous gasket practice to fully utilize the potential of the material.

A-009
Alexander, T.E.
How To Maintain Mechanical Seals
Oil and Gas Journal, V. 60, p. 123, 4+, Feb. 12, 1962

The six causes of trouble in mechanical seals are: 1) Alignment, 2) Faulty installation, 3) Wrong application, 4) Corrosion, 5) Temperature, 6) Solids.
Design ▫ pressures up to 1,500 psi, temperature to 500°F, and rotating speeds to 40,000 rpm. Alignment, 0.002 in. max. for seal faces.
Drawings and tables.

A-010
Allen, C.M., Bell, J.C., and others
Rotating-shaft Helium Seal Investigation
Battelle Memorial Inst., Columbus, Ohio, NP-11243 Contract DA-44-009-eng-3375 (71 pp.)
Aug. 25, 1959

A research program was conducted to study positive rotating-shaft seals using helium for high speed turbomachinery.

A-011
Allen, D.S. and Whitley, S.
Improvements In Or Relating To Devices For The Sealing Of A Rotatable Shaft In Passage Through A Casing
British Patent 881,877, Nov. 8, 1961

A device for sealing a rotatable shaft in passage through a casing is designed which has a diametral clearance between the shaft and the sleeve so small that a small feed of sealing gas is sufficient and leakage rates are low.

A-012
Allen, R.E.
Hydraulic O-Ring Packing For Sealing Cylinders And Pistons
Prod. Engrg., V.18, pp. 163-166, July, 1947

Groove designs for non-moving and moving types of O-ring seals in hydraulic units and other applications. Arrangements shown for sealing cylinders, pistons, end caps, valve covers and adjustable threaded parts. Sealing action of O-rings and properties of compounds available for making O-rings are described.

A-013
Alpert, D.
Recent Advances In Ultra-high Vacuum Technology
Vacuum, V. 9, No. 2, pp. 89-96, May, 1959

The two major directions for advances in ultra-high vacuum technology are: 1) the attainment and measurement of pressures below 10^{-10} mm Hg, and 2) the development of large ultra-high vacuum systems. Included are comments and drawings of seals. Knife edge flange arrangement utilizing a flat copper gasket; the step type with copper jackets; O-ring type; and gold gasket seal.

A-014
Altimus, M.E. Jr.
Trouble Shooting In Hydraulic Systems
Coal Age, V. 61, pp. 75-81, March, 1956

Methods of detecting leakage. Some features of hydraulic components often overlooked as sources of trouble shooting. Diagrams, photograph, labels.

A-015
Andrews, Julian N.
Hollow Metal O-Rings. Seals For Extreme Environments
Product Engineering, V. 33, pp. 47-57

Design guide for low and high temperature O-ring joints includes pressure limits, material selection, surface finishes, groove dimensions, and bolting forces. Temperatures from cryogenic temp. to over 2000°F. Plain hollow, pressurized hermetic, and self energized, 100 to 400 psi. Plating and coatings improve sealing.

Effects of venting O-rings, photographs, temp/stress curve, material use table, O-ring sealing force curve, O-ring vs. solid metal gasket table, pre-installation dimension table, drawings, design procedure.

A-016
Anon.
Packing As A Product Of The Rubber Factory
Ind. Rub. Wld, 3300 W, Sept. 10, 1897

Gives history of the use of packing with illustrated description of types.

A-017
Anon.
Packing Ring For Piston Valves
Mech. Eng., V. 4, p. 752, Nov. 18, 1899

A description of a packing ring for piston valves for a heavy freight locomotive built for the Illinois Central Railroad by the Brooks Locomotive Works. The packing ring is made in one solid piece, and turned to a larger diameter than the bore of the bushing. A saw cut is made on the level across the ring and a shim of the required thickness is inserted. The ends are then clamped together by a bolt, with lugs for this purpose being provided on the inside of the ring and accurately turned to the proper size. The design seems to have the advantage of a plain plug valve, and an additional one in that the valve may at any time be made tight with comparatively little expense.

A-018
Anon.
Labyrinth Packings
Engineering, V. 85, pp. 35-36, Jan. 10, 1908

A general description of labyrinth packings, pointing out that the essential idea on which the packing is based is not so much the causing of the steam to take a tortuous path as to wire draw it at a great number of points. In the latter part of the paper a formula for the discharge of steam through packings of this kind is established.

A-019
Anon.
Buhne Fibrous Babbitt Packing
Power, V. 42, p. 616, Nov. 2, 1915

Buhne fibrous babbitt packing is composed of long, fine fibers of composition metal for steam, water, oil, and ammonia. For each purpose a different alloy is used. Drawing and instructions for packing new and worn rods.

A-020
Anon.
Molding Metallic Packing For Saturated Steam Locomotives
Railway Mechanical Eng., V. 90, pp. 264-5, May, 1916

A-021
Anon.
Piston Rings
Mech. Wld., June 22, 1917

Types of rings used and points in removing and refitting.

A-022
Anon.
Sarco Metallic Gaskets
Power, V. 47, p. 473, April 2, 1918

A combination lead and copper gasket developed by the Sarco Company. For flange work, the lead ring forms the inner member, and just fitting over the outer edge is a copper ring of smaller cross section. This permits the lead ring to come under considerable pressure in tightening the joint before the flange begins to compress the copper ring. The copper prevents the blowout of the lead ring. Details, application and design drawings presented.

A-023
Anon.
Development Of John Crane Flexible Metallic Packing
Int. Marine Eng., V. 23, p. 318, May, 1918,
Ind. Management, V. 55, p. 423, May, 1918,
Power, V. 47, p. 689, May 14, 1918

A-024
Anon.
Mixtures For Metallic Packing
Foundry, V. 46, p. 271, June, 1918

A-025
Anon.
Cast Iron Piston Rod Packing
Railway Mechanical Engineering, V. 93, pp. 577-8, Oct., 1919

The London and North Western, and the North Staffordshire, having experienced difficulty with their white metal piston rod packing on superheater locomotives, have successfully developed a cast iron packing which has given particularly good service for some little time. L & N W RR uses a mixture of 40% selected scrap, 30% Kettering silicon material, and 30% old ingot molds (Hematite). The N.S. RR makes its packing from an ordinary commercial quality of cast iron with approximately 33% Barron Hematite added.
Detailed drawings of both packings are included.

A-026
Anon.
Steam, Hydraulic And Miscellaneous Packings
Belting & Transmission, V. 16, pp. 19-21, June 20, 1920

Notes on materials used in construction, how they are applied to engines, pumps, valves, etc., and conditions affecting their operation.

A-027
Anon.
Ring Packed Stuffing Box For Valve Stems
Railway Review, V. 67, pp. 482-3, Sept. 25, 1920

A-028
Anon.
Tiptop Plastic Metallic Packing
Power, V. 52, p. 864, Nov. 30, 1920

Tiptop packing fits in the stuffing box lengthwise. Being wedge-shaped, it fits the stuffing box and rod, making practically a true circle when the packing is forced against the rod or valve stem as the gland is forced into place.
It is made of a soft shredded anti-friction alloy which is permeated with graphite and mica and then compressed into bars, segments, or into rings which may be cut diagonally with an ordinary jack knife to fit the rod or box.

A-029
Anon.
Throttle Stuffing Box For Plastic Packing
Railway R., V. 70, p. 166, Feb. 4, 1922

A-030
Anon.
Failure Of Labyrinth Packing Shuts Down Turbine
Power, V. 55, p. 211, Feb. 7, 1922

This article describes an accident which occurred at a power company due to a packing failure and the measures taken to correct it.

A-031
Anon.
Use Of Non Metallic Packing In Refrigerating Field
Refrigerator W, V. 57, pp. 29-30, Nov., 1922

A-032
Anon.
All Metal Packing For Locomotive Air Pumps
Railway Review, V. 75, pp. 141-42, July 26, 1924
Railway Age, V. 76, p. 1410, June 11, 1924

The packing rings, two in number, are constructed with mechanical accuracy from four segments which break joints in the center of the rod bearing surface. The combination of two rings working in unison will prevent leakage of either steam or air. The wide bearing surface each ring has on the rod and the grooves of the case insures long life.
Drawings and description included.

A-033
Anon.
Alden Turbine-condenser Expansion Gasket
Power, V. 60, pp. 705-6, Oct. 28, 1924

To withstand temperatures that would prevail under atmospheric conditions, the expansion gasket is made of high-temperature gum rubber in the form of a circular tube provided with two small openings for the introduction and circulation of water under pressure as low as 10 lb./sq. in. Drawings and data curve indicating inflation pressures at which leakage starts.

A-034
Anon.
Steam Engine Packing
Power Engr., V. 20, pp. 175-7, May, 1925

Review of requirements of good packing and of methods adopted to fulfill these practices.

A-035
Anon.
Cooke Seal Ring Can Be Adapted To Any Rotating Shaft
Power Plant Engineering, V. 30, pp. 872-3, Aug. 1, 1926,
Power, V. 64, p. 382, Sept. 7, 1926

The seal is rotated with the shaft. This particular style uses double seal rings, one at either end of the stuffing box, with a spring between to exert the pressure necessary to effect the seal.
Detailed description and assembly drawing.

A-036
Anon.
Packing Glands For Large Steam Turbine Shafts
Power Plant Engng., V. 30, pp. 947-950, Sept. 1, 1926

This article discusses in brief the details of some of the packing glands used on large steam turbines. A few are: carbon ring, water seal and labyrinth gland.
Illustrations.

A-037
Anon.
Artan High Pressure Cast Iron Metallic Packing
Railway Age, V. 82, p. 669, Mar. 5, 1927
Mechanical Eng., V. 49, p. 170, Feb., 1927

The packing consists of a series of ground cups which fit against each other forming a steam tight seal when pressed into the bottom of the stuffing box by the gland. Each packing ring set consists of two rings of rectangular section placed side by side with two cast iron spring rings surrounding the outer circumference of the two sealing rings.

A-038
Anon.
Britimp Metallic Packing
Engineering, V. 123, pp. 402-3, April 1, 1927

A type of packing ring which is self aligning, and when once correctly adjusted, it is impossible to increase the pressure on the rod or shaft. (7 types pictured). Applications are discussed.
A running life of 125,000 miles without adjustment has been recorded, compared with 22,000 with white metal packing.

A-039
Anon.
Packing For Hydraulic Machines
Power, V. 65, p. 969, June 21, 1927

A discussion of various packing materials. The limitations and advantages of braided flax packing, asbestos packing, hemp packing, granulated wood and metal packing, plastic-metallic packing, and braided cotton packing.

A-040
Anon.
Armor-clad Flexitallic Gasket
Power Plant Engineering, V. 33, p. 598, May 15, 1929
Blast Furnace & Steel Pl., V. 17, p. 727, May, 1929

A gasket designed to take care of the most severe modern service conditions - high temperature, high pressure, and acid conditions. The elasticity of the gasket was not exceeded at 100,000 pounds load (9000 lb/sq. in.).

A-041
Anon.
Spring Packing For Steam Turbine Stuffing Boxes
Marine Eng., V. 35, p. 83, Feb., 1930

V-shaped grooves on the outer circumference of rings of corresponding shape are held in position by a tension wire. Between the ends of the wire a corrugated spring is provided, which is under compression. Test data, tabulated and discussed are presented.

A-042
Anon.
Selection And Application Of Pump Packing
Nat. Pet. N., V. 22, p. 61, May 7, 1930

A-043
Anon.
High Pressure Gasket Pointers
Pulp & Paper Magazine of Canada, V. 30, p. 428, Oct. 9, 1930

A-044
Anon.
Carbon Packing Rings For Steam Turbines
Power Plant Engineering, V. 34, p. 1219, Nov. 1, 1930

A discussion of carbon packing rings, stressing the care of fit, spring pressure and examination. Some troubles similar to those caused by electrolytic action, and the correction of same.

A-045
Anon.
Typical Designs Of Stuffing Boxes
Product Eng., V. 3, pp. 25-6, Jan., 1932

Formulas for proportioning cast-iron stuffing boxes with brass glands; equations for calculating principal dimension when other materials are used or higher pressures are involved.

A-046
Anon.
Alco Plastic Metallic Packing
Railway Mech. Eng., V. 106, p. 42, Jan., 1932

The particular advantages of this new packing include ease of application and renewal, durability, reduced friction and the maintenance of steam and fluid-tight joints under most adverse conditions.
Alco is a plastic self-forming packing, composed of porous all-metallic kernels, saturated with non-drying lubricants.
Temperatures up to 600°F.

A-047
Anon.
Protecting Bearings With Unit Oil Seals
Machine Design, V, 4, pp. 30-2, March, 1932

Oil retaining rings and packings for plain and roller bearings; shafts from 1/2" to 2" dia.

A-048
Anon.
Self-contained Oil Seal For Bearings
Engineering, V. 133, p. 502, April 22, 1932

Single seal introduced by Charles Weston; known as "Gits" precision oil seal, and is standardized for shafts ranging in diameter from 5/16 in. to 6 in.; consists essentially of special form of self-contained unit.

A-049
Anon.
Garlock Packing Co. Expansion Gasket
Railway Age, V. 92, p. 1035, June 18, 1932

Photograph and paragraph describing a recently developed gasket known as the Guardian. Designed to meet any requirements of pressure or temperature, to resist the corrosive effects of gasses and liquids, and to maintain tight joints under changing temperatures with continued resiliency.

A-050
Anon.
Granola Metallic Packing
Canadian Engineer, V. 63, p. 46, July 19, 1932

A-051
Anon.
Protecting Bearings With Unit Oil Seals
Machine Design, V. 4, No. 8, pp. 30-2, Aug., 1932

Describes the advantage of unit oil seals. The use of cork, leather, and asbestos as packing members is discussed, as is shaft whip and piston ring arrangement.

A-052
Anon.
Plastic Metallic Packing
Engineer, V. 154, p. 338, Sept. 30, 1932

New type of packing marketed under trade name of "Sealite" and made by R.C. Taylor and Co.; consists of 87% of finely divided non-fibrous lead-base alloy, to which has been added 10% of graphite and small amounts of long-strand asbestos.

A-053
Anon.
New Method Of Packing Expansion Joints; Another Piping Problem Solved (Yarnall-Waring Co.)
Power, V. 76, pp. 236-7, Nov., 1932

Expansion joint, force packed by "guns" on shell, forces semi-plastic packing through a drilled channel into the stuffing box. Packing ingredients are long-filler asbestos, graphite, and inorganic filler impregnated with high test oil.
Discussion of operational run. Drawings.

A-054
Anon
Stuffing Boxes Packed Under Pressure
Power Plant Eng., V. 36, pp. 814-5, Dec., 1932

Lubricated packings forced around slip joint cylinders with pressure maintained on joint.

A-055
Anon.
Spring Fitted Oil Sealing Ring
Engineering, V. 135, p. 30, Jan. 6, 1933

The device is known as the "Perfect" oil and grease retainer.
The leather ring with the tightening spring is enclosed in a light casing with a cover held in place by a beaded edge.
Manufacturing tolerances, operation, and application discussed. Drawing included.

A-056
Anon.
Haughtons Metallic Packing
Soc. Chem. Ind. Journal (Chem. & Ind.)
V. 53, pp. 187-8, Feb. 23, 1934,
Chem. Age (London), V. 30, p. 230, March 17, 1934

A-057
Anon.
Closures For Ball And Roller Bearings
Mech. World, V. 96, pp. 177-9, Aug. 24, 1934

Details of a number of different types of lubricant retaining closures which form simple and adequate protection under various conditions of service.

A-058
Anon.
Hoyt Metallic Piston Rod Packing
Engineering, V. 138, p. 484, Nov. 2, 1934,
Engineer, V. 158, p. 422, Oct. 26, 1934

A new packing ring for the glands of piston rods, given the name of "Silver Ring Packing." Differs from babbitt, but possesses high anti-frictional properties. The metal is made up in the form of conical washers with double bevelled edges which provide parallel faces to bear against the rod and the interior of a stuffing box. These packings have been given some very severe trials and are said to be effective from vacuum to 5000 lb/sq. in. Picture included.

A-059
Anon.
Flow Through Labyrinth Packing
Mech. Engrg., V. 56, pp. 678-680, Nov., 1934
(Abstract translation from Die Warme, Aug. 11, 1934, V. 57, pp. 513-517)

Application of the formula for the derivation of the labyrinth equation.

A-060
Anon.
Investigations Of Packings For Stuffing Boxes And Hydraulic Cylinders (In German)
Munich and Berlin, R. Oldenbourg (22 pp.), 1935
(Eng. Soc. Lib., N.Y.)

Tests made at laboratory of Berlin Institute of Technology; imperviousness, leakage, and frictional resistance of 9 popular packings was determined.

A-061
Anon.
Anti-friction Metallic Packings
Chemical Age (London), V. 33, p. 286, Sept. 28, 1935

A-062
Anon.
Seals Against Fluid Pressure, Pt. I; An Approach To The Problem Of Preventing Leaks In A Power Plant
Power Plant Engineering, V. 40, No. 5, pp. 280-2, May, 1936

Packing specially developed; procedure in preventing leaks.

A-063
Anon.
Glands And Seals In Turbines
Power, V. 80, p. 307, June, 1936

A brief general description of labyrinth, water, and carbon ring seals, with drawings of a few typical examples. No data.

A-064
Anon.
Seals Against Fluid Pressure, Part II; Materials Used As Principal Constituents Of Packing And Gasket
Power Plant Engineering, V. 40, No. 6, pp. 354-6, June, 1936

Material characteristics which suit them as packing and gasket constituents: aluminum, asbestos, asphalt, babbitt metal, brass, bronze, cardboard, cork, canvass, duck, felt, fiberboard, flax, graphite, hemp, iron, jute, lead, leather, linen, mica, Monel metal, nickel, oils, paper, papier-mache, paste and plastics, rubber, soapstone, steel, tallow, tar, wood, wool.

A-065
Anon.
Seals Against Fluid Pressure, Part III; Specifications For Sheet Packings Used In The Making Of Fixed Joints
Power Plant Engineering, V. 40, No. 7, pp. 416-9, July, 1936

Rubber packing and gaskets; molded, sheet, and strip. Rubber, cloth insertion sheet packing; rubber, wire insertion sheet packing; compressed asbestos sheet packing; asbestos, metal sheet packing.

A-066
Anon.
Seals Against Fluid Pressure, Part IV; Specifications For Gasket, Diaphragm Packing, And Fabric Packing For Condenser Tubes
Power Plant Engineering, V. 40, No. 8, pp. 482-4, Aug., 1936

Asbestos-copper corrugated gasket; asbestos metallic cloth gaskets; metallic-encased gasket, diaphragm packing; fabric condenser tube packing.

A-067
Anon.
Seals Against Fluid Pressure, Part V; Materials Used And Specifications For Making Seals Where Sliding Contacts Are Necessary
Power Plant Engineering, V. 40, No. 9, pp. 536-9, Sept., 1936

Braided asbestos rod packing; asbestos valve stem packing; spiral gland low pressure packing; tucks packing; leather hydraulic packing; flexible metallic packing; metallic and non-metallic packing; semi-metallic packing.

A-068
Anon.
Seal-lubricant In, Dirt Out
Electrical Mfg., V. 18, pp. 27-30, Nov., 1936

Designs of various types of ball bearing dust and dirt seals; a chart showing different type seals and how effective they are under various conditions; spring pressure seals for severe service; preventing oil leakage past a plain bearing.

A-069
Anon.
Seals Against Fluid Pressure, Part VI; Types Of Flange Faces Used On Power Plant Piping And Physical Requirements Of Gasket Materials
Power Plant Engineering, V. 40, No. 11, pp. 643-61, Nov., 1936

Flange faces with matched surfaces; purpose of gaskets; what squeeze does to gaskets; relation of pressure to compression.

A-070
Anon.
Seals Against Fluid Pressures
Power Plant Engineering, V. 41, pp. 114-116, Feb., 1937

Part VII. Specifications issued by the United States Navy for packings suitable for gaskets, rods, shafts, and condenser tubes. Oil resistant gaskets. Cloth-insertation rubber packing. Unvulcanized rubber-graphite packing. Carbon packing. Shredded lead packing.

A-071
Anon.
Practical Problems In Packing
Power Plant Engineering, V. 41, pp. 128-9, Feb., 1937

A general commentary on good practices for monitoring packings during use and maintenance. No technical data.

A-072
Anon.
Steam Packing For Piston Rod
Engineer, V. 164, p. 357, Oct. 1, 1937

This packing is intended to resist high pressure with a minimum of friction on the rod. It consists of a black packing on the outside, and a cone packing within. Eight blocks are held in strong rings. Two blocks of each set are babbitt lined, the other two act as guides. The joints are staggered to close a through passage. Cone packing bears against a spherical seating. Drawing included.

A-073
Anon.
The Labyrinth Packing
The Engineer, V. 165, No. 4280, pp. 83-84, Jan. 21, 1938

An editorial review of the work of Parsons in developing labyrinth seals for his steam turbines. The article is chiefly historical in value.

A-074
Anon.
Report Of Special Section On Packing Classification
Proceedings Am. Soc. for Testing Materials, V. 39, pp. 476-7, 1939

A proposal for a classification of rubber-containing gaskets, valve disks, sliding contact packings, and diaphragms to be employed in the future proceedings of Subcommittee VI.

A-075
Anon.
Rodpak Mfg. Co. Develops Rod Packing For Severe Conditions
Steel, V. 104, p. 77, April 10, 1939
Refrig. Eng., V. 37, p. 117, February, 1939

This packing employs two metal rings (convex on one face and flat on the other) as the sealing medium on the shaft. For some applications these rings are made of a special babbitt metal, while for others a metal which will resist heat up to 700°F is employed. Between these sets of rings are rings of Neoprene, concave on both faces, to mate with convex surfaces or rings.

A-076
Anon.
Neoprene Being Successfully Used For Compressor And Pump Rod Packings
Mach., V. 45, pp. 582-3, April, 1939

A-077
Anon.
Current Types Of Gaskets And Closures
Heating-Piping and Air Conditioning, V. 11, pp. 500-1+, 565-6+, Aug./Sept., 1939

The usual bolted joint construction is being largely modified or superseded by more reliable, more easily maintained, and more economical forms. The author describes several of these current type gaskets and closures.
Manhole type joints, ring type joints, bellows type joint, formula for force calculation, and drawings included.

A-078
Anon.
Laminated Gaskets
Engineer, V. 168, p. 384, Oct. 13, 1939

The "Dixon" gasket consists entirely of a number of laminations. Materials can be varied. In marine and aircraft engines, only copper laminations may be used. Copper and terne plate was found advantageous. Copper-aluminum and aluminum-terne have also been used.
Drawings included.

A-079
Anon.
Dickson All-metal Laminated Gasket
Engrg., V. 148, p. 540, November 10, 1939

A static gasket composed of thin metallic laminations; used as head seal for internal combustion engines; can be used both hot and cold.

A-080
Anon.
Seals Rotate With Shaft
Neoprene Notebook, p. 118, July-Aug., 1940

A radial type seal is described in which neoprene is successfully used as the sealing material. Features of seal most attractive to design engineers are listed.

A-081
Anon.
New Material For Gasket; Layers Of Synthetic Rubber Buna And Steel Wire Netting
Automotive Industries, V. 83, pp. 265-6, Sept. 15, 1940

A-082
Anon.
Neoprene and Asbestos Used In The Production Of Gaskets
Machinery, V. 47, p. 169, Nov. 1940

Two types are available. One type has considerable compressibility and is adapted for joints where relatively light flange pressure is applied. Advantages of new gasket are permanency of size and ability to resist the effects of relatively high temperatures.
Second type for heavier flange pressures.
Description of manufacture and advantages.

A-083
Anon.
Gland Design For R. W. Engines
British Motor Ship, V. 22, pp. 281-284, Dec., 1941

Article discusses an original piston rod gland design used on a Richardson Westgarth double-acting oil engine. Manner in which design was improved through detail developments is covered. Of equal importance to design was need for accurate workmanship and ascertainment of best working clearances to give best all-around results.

A-084
Anon.
Construction And Action Of Stuffing Boxes
Mech. World, V. 110, pp. 459-62, Dec. 26, 1941

Analysis of a variety of common and special type stuffing boxes.

A-085
Anon.
Lead Lubricant Combined In A Rubber Gasket; Swing Joint For Low Pressure Steam Line
Scientific American, V. 166, p. 66, February, 1942

The secret of the efficiency of the joint lies in a rubber gasket into which powdered lead is milled before the gasket is shaped. Because of the lubricating action of the lead, it is claimed that the new joint turns more freely under pressure than other types and that the lead lengthens the life of the gasket. The swing joint handles steam pressures up to 100 psi.

A-086
Anon.
Rayon Rope Seals In The Power Of Vital Hydraulic Machines
Rayon, V. 23, p. 672, Nov., 1942

A-087
Anon.
Formula For Packing Ring Length
Oil Weekly, V. 108, p. 30, Feb. 15, 1943

Formula requires knowledge of rod and plunger diameter, width of gland or box, and proper packing thickness. All of this information is available from factory specifications on pump, or may be experimentally determined at first shutdown.

A-088
Anon.
Gasket Material
Modern Plastics, V. 20, pp. 78-9 and 156, May, 1943

High tensile, fibrous sheet material impregnated with phenolic plastic developed by Detroit gasket manufacturer from which he cuts various types of gaskets for most exacting aircraft engine requirements; new material is reported to have passed severest tests under all conditions and has been accepted as alternate material by aviation industry; manufacturing process illustrated and described.

A-089
Anon.
You Can Pack Centrifugal Pumps To Hold High Pressures And Temperatures
Power, V. 88, pp. 8-10, 62a, Oct., 1943

Discussion of problems involved; classification of common types of packings and applications; general arrangements of sealing systems.

A-090
Anon
New Type Of Resilient Seal Simplifies High-pressure Valve Design
Product Eng., V. 15, pp. 158-9, March, 1944

Description of T-section seal developed by Maytag engineers for application to valves used in machine tool applications and in airplane hydraulic systems.

A-091
Anon.
O-Ring Packings Simplify Lightweight Hydraulic Equipment
Prod. Engrg., V. 15, pp. 581-585, Sept., 1944

Details of dimensional tolerances, materials, lubrication, finish of surfaces, frictional characteristics, and causes of failure are given. Reciprocating, static, and rotary seal applications are considered.

A-092
Anon.
Bellows-type Shaft Seal
Oil & Gas Journal, V. 43, p. 133, Oct. 21, 1944

A-093
Anon.
Silicone-rubber Gaskets Used In Navy Searchlights
Elect. Eng., V. 63, p. 455, Dec., 1944

Silicone rubber which retains its elastic properties at temperatures as low as 60 degrees below zero or as high as 575 degrees Fahrenheit, is now being used for gaskets for Navy searchlights. Its advantages, performance and other uses discussed.

A-094
Anon.
Packing, Engine And Pump
Mechanical Packing Manual, Graton and Knight Company, Worcester, Mass., 1945

A-095
Anon.
Packing - "U" Cup Hydraulic
P.B. 36832 - Off. Tec. Ser., Apr., 1945
(Army-Navy Aeronautical Standard Drawing AN6226)

This third revision of the ANA Standard for "U" cup hydraulic packing for pressures up to 600 psi gives the drawings showing the size and location of markings.

A-096
Anon.
Rotary Seal Is Extremely Compact
Machine Design, V. 17, p. 157, June, 1945

A rotary sealing unit of extremely compact design suited especially to use in fluid clutches, hydraulic transmissions or torque converters, and similar equipment, is covered by patent 2, 362, 341 recently assigned to General Motors Corporation. As illustrated in the accompanying exploded drawing, the design provides a concentric nonmetallic sealing nose with a separately pocketed spring loading arrangement. Short descriptive article. No data.

A-097
Anon.
New Packing Resists Corrosion And Heat
Iron Age, V. 155, p. 68, June 7, 1945

Flexible metallic packing capable of withstanding temperatures up to 2000°F and is highly resistant to corrosive gases, alkalies and most acids.

A-098
Anon.
Graphite Bearings And Seals
Heating & Ventilating, V. 42, p. 88, Sept., 1945

Carbon-graphite, which has self lubricating properties and a low coefficient of friction, is manufactured as Graphitar in various shapes and sizes to serve as air compressor and steam engine piston rings, cylinder liners, grease seals, turbo blower seals, etc. Resists chemical action and wear, is mechanically strong and light. Tensile strength 750 to 2500 lbs. per sq. in. Compressive strength 1850 to 37,000 lbs. per sq. in. Breaking strength 3750 to 13,000 lb. per sq. in.
Rebound (concrete floor) 70% of the height dropped. Oxidizes slowly and loses weight at 700°F.

A-099
Anon.
Information On Manufacture Of Oil Seal Rings (Simmer rings)
(Naval Tech Mission in Europe Tech. Rept. 375-45), Sept., 1945, Off. Tech. Serv. PB-22819

This report is a brief description of the manufacture of "Simmer Rings," and a record of disposition made of drawings and samples removed from the plant of Walter, Hans, Otto and Richard Freudenk, Weinheim, Germany. These seals are used for preventing leakage of oil from bearings, for hydraulic packing and for other sealing purposes on rotating and reciprocating shafting of all types and sizes which operate within the temperature limitations of the rubber or leather used in the manufacture of the rings.

A-100
Anon.
Metallic Gasket Materials
Paper Ind., V. 27, p. 926, Sept., 1945

A-101
Anon.
Ajax Spiral Wound Gaskets
Marine Eng., V. 50, p. 220, Nov., 1945

Contrasted to the ordinary static seal as obtained with all metal gaskets or sheet packing. The Ajax spiral wound metal and asbestos gasket can be engineered for any specified service to give a predetermined compressibility and resiliency. The knifelike edges of the metal in Ajax gaskets seat themselves in a continuous spiral groove in the joint faces at a relatively low bolt stress. Description, picture, curves, and detail of sealing action.

A-102
Anon.
Sealing Motor Bearings
Elect. Rev. Lond., V. 137, p. 756, Nov. 23, 1945

A simple design of seal that prevents leakage of mineral oil and the ingress of foreign matter into the ball or roller bearings of an electric motor is described. The shaft is encircled by a stationary packing member of L-shaped section which is kept in light running contact with the shaft by a spring. The material used for the seal depends on the temperature and peripheral speed. When conditions require it, a dual type can be fitted.

A-103
Anon.
Pump Shaft Seal
Product Engineering, V. 16, p. 832, Dec., 1945

Heat resistant and noncorrosive are the characteristics of new seal; available in both bronze and stainless steel.

A-104 T
Anon.
Steam Turbines: Seals And Glands
Power, V. 89, pp. 800-1, Dec., 1945

A basic description of seals and glands used in steam turbines is given. Included are carbon rings, labyrinth seals, and water glands.

A-105
Anon.
Packings And Gaskets; Hydraulic
PB21549, Off. Tech. Ser. (22 pp.)(AN-1+H P-114b)
PB34918, Off. Tech. Ser. (36 pp.)(with amendment 1, Mar. '46)

A-106
Anon.
A Seal For A Rotating Shaft
Engr., V. 182, p. 218, Sept. 6, 1946

Brief description of an English shaft seal employing a "Hydroflex" metal bellows.
Design problems discussed.
Applicable to air-compressors, pumps, gear boxes, paper machinery, and chemical plant.

A-107
Anon.
Typical Methods Of Sealing Rotating Shafts
Prod. Engrg., V. 17, pp. 108-109, Oct., 1946

Shaft seals, used to prevent seepage of lubricating oils or other liquids, range from simple flange packings to elaborate bellows and lapped surface devices. Some of these, utilizing wave, coil, and garter springs, diaphragms, and locking rings, are described and illustrated.

A-108
Anon.
Life Stories Important In The Oil Fields
Inco., V-21, pp. 18-19, Winter, 1946-1947

Parts of new type pump for handling sour crude oil are made of monel, except for the graphite-impregnated plastic packing rings.

A-109
Anon.
Sealing Rotating Shaft
Soc. Chem. Industry (Chem. & Industry), p. 21, Jan. 11, 1947

Details of bellows shaft seal particularly suitable for shaft seal assembly in refrigeration compressors, pumps, gear boxes, paper machinery, and chemical plants.

A-110
Anon.
Press-fit Tolerances Maintained in Following Production Line Technique To Turn Out Millions Of Oil Seals
Steel, V. 121, pp. 86-87, 116, 118, 121, Oct. 13, 1947

Production line methods used in the manufacture of seals.

A-111
Anon.
Sealing Of Hydraulic Compartment Access Door, C54 Series, Douglas
U.S. Air Force
P.B. 91771 - Off. Tech. Ser., Mar., 1948

1. C54 (Airplane)
2. Airplanes, hydraulic compartment sealings
3. Fire prevention
4. AAF to 01-40NM-189

A-112
Anon.
Typical Ball Bearing Seals And Internal And External Slinger Rings
Product Engineering, V. 19, pp. 110-1, Oct., 1948, pp. 122-3, Nov., 1948

Design illustrations showing lubricant retention and dirt resistance functions of spring; flange and labyrinth seals; and plain, grease-groove and felt shields.

A-113
Anon.
Flange Type Seals For Ball And Roller Bearing Application
Product Eng., V. 19, pp. 122-3, Nov., 1948

Flange-type seals are so designated because they use a flange shaped sealing member with a wiping lip that lightly presses against the shaft.
62 examples (by cross sectional drawing), material identification and linear speed.
Felt; asbestos; cork; oak leather; 700 lineal f.p.m.
Chrome leather, 1000 lineal f.p.m.
Compositions, 1000-20000 f.p.m.

A-114
Anon.
Carbon Packing Rings
Mech. Eng., V. 71, pp. 159-61, Feb., 1949

A method of manufacturing carbon packing rings such as those used in turbines that results in a uniform precision interchangeable sectional carbon ring.
The description of the operation is laid out in twelve steps. Photographs included.

A-115
Anon.
Various Designs And Methods Of Sealing Available For Fluid Conveying Systems In Machines
Machine Design, V. 21, pp. 106-109, July, 1949

Various types of fittings commercially available and their basic design characteristics. Cross-section views of 20 different types and how they seal.

A-116
Anon.
These Five Gasket Types Do Most Of The High Pressure Work
Chem. Eng., V. 56, pp. 118-20, August, 1949

Description and drawings of the "Budgeman" type, the "delta" type, Wave ring, O-ring, and Lense-ring gasket. Brief discussion of each.

A-117
Anon.
Labyrinth Seals
Aircraft Production, V. 11, pp. 289-290, Sept., 1949

Used in gas-turbine engine of the British Armstrong Siddeley Mamba for pressure sealing between rotating and fixed members. Forming equipment and procedure for manufacture of the "fins" used in these seals.

A-118
Anon.
Modern Oil Leaks
Sci. Lubrication, V. 1, pp. 2-5, Nov.-Dec., 1949

Description of Gaco M.I. oil seal for rotating shafts, which is manufactured by George Angus Co. Ltd., New Castle on Tyne, England; advantages of Gaco synthetic rubber material when employed in conjunction with "hairline" contact of sealing lip; manufacture and testing, proper care and fitting.

A-119
Anon.
Electric Motor Lubrication
Lubrication, V. 36, pp. 1-12, Jan., 1950

An excellent general description of motor bearing types and lubrication. Factors effecting selection of equipment and methods.

A-120 T
Anon.
Mechanical Seal Design
The Chemical Age, V. 62, p. 328, Mar. 4, 1950

This abstract of a booklet published by a packing manufacturer deals with three principal considerations which influence the performance of a mechanical seal, namely shaft conditions, material and wear.

A-121
Anon.
Aluminum Foil Laminate Gasket
Journal of Metals, V. 188, p. 839, June, 1950

An interesting gasket material has been developed, based on an aluminum foil laminate bonded with special synthetic resin. In use, its capacity for plastic deformation is such that it will readily take up all surface forms against which it is bolted, including machining marks.
General, brief discussion.

A-122
Anon.
How To Be Happy With Teflon Packing
Chem. Eng., V. 57, pp. 229-239, July, 1950

Selection, fabrication, fit and run in, are steps discussed in detail. Compounded, not pure for rotating shafts; proportioning pumps regulator valves; centrifugal pumps; agitators; reactors; autovalves and solid teflon gasket.

A-123
Anon.
Seal Makes Pump Self-priming
Steel, V. 127, p. 106, Aug. 14, 1950

Explains that the purpose of the mechanical shaft seal on self priming centrifugal pump is to prevent leakage of liquid or entrance of air where the rotating pump shaft enters the stationary pump housing.

A-124
Anon.
Plastic Packing
Blast Furnace And Steel Plant, V. 38, p. 1350, Nov., 1950

A special new feature to "Super Seal" plastic packing. A securely vulcanized tape-back is now offered as an integral part of all "Super Seal" spiral packings. Increased flexibility.

A-125
Anon.
Chemlon V-Ring Packing Molded Of Teflon
Modern Plastic, V. 28, p. 148, Feb., 1951

Product announcement of long-life frictionless valve seal provided by tetrafluoroethylene packing.
Photograph.

A-126
Anon.
Stuffing Box For High Pressure Orifice Meter
Machine Design, V. 23, p. 204, Mar., 1951

The heart of the stuffing box is a combination packing and bearing machined from Teflon which is tough and chemically resistant. 5000 psi - 450°F. Shaft torque only 9.7 gram-inches.
Photograph and discussion.

A-127
Anon.
Mechanical Seal
Blast Furnace And Steel Plant, V. 39, pp. 718-19, June, 1951

The new shaft seal performs effectively under severe temperature and corrosive conditions. The seal incorporates a flexible ring molded from Teflon. The Teflon "wedge-ring" enables this seal to combine the chemically-inert properties of Teflon with the flexibility and positive sealing components essential to effective mechanical sealing.

A-128
Anon.
High Pressure Stuffing Box
Chemical Engineering, V. 58, p. 187, Sept., 1951

Staged packing, with controlled pressure drop across each stage, provides long packing life, minimum shaft wear, and easy maintenance. Range 3000 to 5000 psi and 300 to 600°F.
Rotary Mechanical Seal.
Details of pressure and oil - stage to stage.
(Blaw Knox engineers)

A-129
Anon.
Simple Ways To Seal Slow Speed Bearings
Mill & Factory, V. 49, p. 109, Nov., 1951

Simple and inexpensive methods of sealing; labyrinth seals; endwise movement, counterboring housing can save space; long thin housings; illustrative drawings.

A-130
Anon.
Pressure Filled Metallic O-Rings For Static Seals
Machinery, V. 58, p. 199, April, 1952

Hollow metal tubing rings filled with inert gas at a temperature of 600 pounds per square inch are providing a new answer to static sealing requirements in a wide range of applications. Positive metal to metal static seals, wherever problems of heat, pressure, corrosive liquids or gasses are involved. Stainless steel, mild steel, cadmium or nickel plated, 20,000 psi. Available from 11/16" dia. to 40" dia. in increments of 1/16 inch.

A-131
Anon.
Sealing Cabin Wiring; Molded Multi-cable Plastic Grommets For Pressure-bulkhead Mounting
Aircraft Production, V. 14, p. 115, April, 1952

A-132
Anon.
Beater Saturated Gasketing Materials
Prod. Engrg., V. 23, pp. 164-166, June, 1952

Cellulosic or asbestos fibers treated with water dispersions of rubber or resin prior to being formed into sheet, provide the basis for new classes of gasketing materials.

A-133
Anon.
Spiral Wound Gaskets
Mech. Eng., V. 74, pp. 585-6, July, 1952

Spiral wound gasket of 347 stainless steel, 10" dia., with thickness of 0.175" with asbestos filler, temp. to 1800°F, and a stainless steel retainer ring. Presentation of test data and discussion of results. Drawing included.

A-134
Anon.
High Compressibility Fiber Gasketing Material
Automotive Ind., V. 107, p. 59, Sept. 1, 1952,
Product Eng., V. 23, p. 220, Sept., 1952

Features of these materials are that they will not dry out, harden, or shrink on aging or in service; they have high compressibility even under light flange pressures; they will not rupture or crush under flange pressure loads of 100,000 psi; they are homogeneous and impervious and will hold internal pressures from 1000 to 2000 psi materials: cellulose fibers, finely ground cork, and synthetic rubber, asbestos.
Data discussed.

A-135
Anon.
Teflon, Components And Coatings
Product Engineering, V. 23, pp. 149-153, Sept., 1952

Complete description of teflon, capable of continuous service at temperatures -90 to 500°F. Properties of gaskets and packing. Physical properties of filled teflon compositions. Teflon packing case histories.

A-136
Anon.
Analytical Derivation And Experimental Evaluation Of Short-bearing Approximation For Full Journal Bearings
N.A.C.A. Report 1157, 1953. (Incorporates NACA TN 2808+TN2809)

An approximate analytical solution including the effect of end leakage from the oil film of short plain bearings is presented because of the importance of endwise flow in sleeve bearings of the short length commonly used. Analytical approximation is supported by experimental data. Approximating a maximum bearing temperature, and evaluation of effect of deflection in misalignment on eccentricity ratio at the ends of the bearing, are discussed.

A-137
Anon.
Treat Your Compressor Seals Right
Power, V. 97, p. 122, Dec., 1953

Discussion of shaft seals, coil spring, bellows, and balanced packings. Also discussion of leaks, choosing the seal, and maintenance.

A-138 T
Anon.
Rotary Shaft Seal
The Engineer, V. 197, pp. 293-294, Feb. 19, 1954

This article describes a cartridge type mechanical face seal for shafts rotating at high speeds.
Standard models: - Shaft size, 1/4-inch to 7 1/4" dia.
- pressure to 50 lbs. /sq in.
- temp. to 130°C

A-139
Anon.
The O-Ring Spiral Failure Problem
Applied Hydraulics, V. 7, pp. 90-94, March, 1954

Discussion of O-ring failure:
Types of failures; probable cause; conditions which effect the normal load; conditions which effect static sliding and rolling coefficients; conditions which effect the contact area; other conditions that can accelerate or induce spiral failure and weaken the ring structurally; corrective action.

A-140 T
Anon.
Keeps Seal Tight At High Temperatures
Chemical Engineering, V. 61, p. 264, Oct., 1954

Stuffing box cooling system used to increase operating temperatures in pumps with mechanical face seals.

A-141
Anon.
Design Manual On Nonmetallic Gaskets
Machine Design, V. 26, pp. 157-188, Nov., 1954

Subjects covered are: 1) Gasket requirements, 2) Materials and uses, 3) Joint and gasket design, 4) Specifications and testing. Description, discussion, data tables, etc.
a) Asbestos products, b) Cork and rubber, c) Cork composition, d) Rubber and plastics, e) Paper, f) Leather, g) Composite and miscellaneous gaskets.
Applications - test - detailed

A-142 T
Anon.
Stopfbuchslose Zentrifugalpumpen (In German)
Konstruktion, V. 7, p. 204, 1955

This sort note describes a centrifugal pump which is sealed by the dynamic head created by a small impeller situated behind the main pump impeller.

A-143
Anon.
Performance Cycling - Test Of High Temperature Hydraulic O-Ring Packings
WADC-TN-WCLS-54-71, WADC, Wright Patterson A.F.B., Jan., 1955

This report describes the methods used to determine the mechanical performance of synthetic rubber O-ring packings in hydraulic fluids at temperatures up to +550°F.

A-144 B
Anon.
Oil And Water Seals In Kaplan Runners
Water Power, V. 7, p. 38, Jan., 1955

(Abstract of article in Technische Rundschau. 46, 26 July, 1954.)

A-145
Anon.
O-Ring Design Factors
Mech. World, V. 135, pp. 64-7, Feb., 1955

O-rings supply simple versatile seals for systems of all kinds containing fluids under pressure; generalized data in tabular form for rapid static or dynamic applications to flange, shaft or piston seals.

A-146
Anon.
Low Friction Fluid Seals
Engineering, V. 179, p. 153, Feb. 4, 1955

A near perfect seal under a pressure range of 0 - 4500 psi consisting basically of a "U" ring. Trade name "Twinset."

A-147
Anon.
Fluid Seal For Reciprocating Shafts; Compound U-Ring And Header
Engrg., V. 179, p. 769, June 17, 1955

A seal which provides a convenient and effective gland suitable for applications involving the reciprocating motion of a shaft is described. A test is described which operated from 0 to 50, 000 psi for 7, 000 operations.

A-148
Anon.
Quad-rings Replace Regular O-Rings In Piston Mechanism
Rubber Age, V. 77, p. 550, July, 1955

A-149
Anon.
High Temperature Hydraulic Seal Research And Development Program. Status Report No. 1
Douglas Aircraft Company, Report Dev. 2030, September 1, 1955.

A systematic approach to high-temperature hydraulics is described which will minimize the possibility of overlooking a promising technique or material, make full use of test facilities, and extract maximum information from test data. Evaluation at high temperature (550°F). Material will be based on the results of the following tests: life cycling, comparative screening, friction, physical properties after hot oil aging or cycling.

A-150
Anon.
High Temperature Hydraulic Seal Research And Development Program. Status Report No. 2
Douglas Aircraft Company, Report Dev. 2030, Nov. 1, 1955

A progress report on the overall project. The program has been divided into two phases, one phase covering 400°F packings for systems utilizing OS-45 fluid, and the other phase covering 550°F packings for use with MIL-0-8200 fluid. An attempt will be made to develop a seal applicable for the glands described in MIL-P-55144. If early indications are such that this approach appears impractical, then standard and non-standard seal configurations will be investigated.

A-151
Anon.
Better Static Sealing
Automation, V. 2, No. 11, pp. 75-76, Nov., 1955

Methods applicable in design of fluid power or control system for aircraft or other installations; in automation equipment, as in aircraft industry, more designs are incorporating O-ring type of sealing where possible; efforts to obtain O-ring quality seals without attendant fitting problems.

A-152
Anon.
High Temperature Fluid Packing And Operating Problems
Applied Hydraulics, V. 8, pp. 74-78, Dec., 1955

General comments on papers presented at fall meeting of SAE-A-6-Committee, Aircraft and Hydraulics and Pneumatic Equipment.

A-153
Anon.
High Temperature Hydraulic Seal Research And Development Program. Status Report No. 3
Douglas Aircraft Company, Report Dev. 2030, Jan. 1, 1956

The following categories of seals are being investigated: 1. Standard AN 6227 configuration O-rings designed for standard glands, 2. Modified O-rings configuration designed for decreased tension in standard glands, 3. Non-standard configuration seals, 4. O-ring backup configurations and design, and packing and gland configuration which will take full advantage of elastomer materials.

A-154
Anon.
High Temperature Hydraulic Seal Research And Development Program. Status Report No. 4
Douglas Aircraft Company, Report Dev. 2030, March 1, 1956

Compounding studies with acrylic rubbers have been continued during the two-month period. Some of the work has been completed and is reported in full. Stress/strain test data are presented on acrylic stocks stressed at 400°F. Stress/Strain values of acrylic rubbers, aged 168 hours in OS-45 at 400°F and stressed at that temperature are low.

A-155
Anon.
Frozen Slugs Seal Shafts
Chem. Engg, V. 63, pp. 124 and 126, March, 1956

How it works, practical considerations, practical experience, limitations and designs.

A-156 T
Anon.
Nuclear Reactors Pose New Problems In Mechanical Design
Product Engineering, V. 27, pp. 197-8, April, 1956

Static seals, and frozen seals for liquid metal pumps are described. Friction heating maintains a liquid film, but high conduction coefficient of liquid metal does not allow the film to become big enough to leak.

A-157
Anon.
Can Liquid Gasketing Cut Your Costs?
Iron Age, V. 177, p. 103, April 19, 1956

Liquid gasketing and insulating material may offer economies - particularly if the present method entails cutting material to size, fitting, and securing by suitable adhesive agents. New material is called Vynafoam Plasticol. Offered by Inter-Chemical Corporation.

A-158
Anon.
High Temperature Hydraulic Seal Research And Development Program. Status Report No. 5
Douglas Aircraft Co., Report No. Dev. 2030, May 1, 1956

Physical properties of stocks previously reported are presented. Thermal activation techniques, such as employed with butyl rubbers, may have some merit, although improvement in properties of these formulations is not large, use of silicone polymers as plasticizers and mill release agents is of doubtful value since physical properties are poorer than stocks formulated without them. Microcel A does not offer the reinforcement of carbon black in Hycar 4021. However, volume increase (swelling) is not one-half that of stocks containing carbon black. Varying the type of amine produces differences in vulcanizate properties after OS-45 fluid immersion at 400°F.

A-159
Anon.
Tubular Rubber Gas Seal
Engineer, V. 201, p. 648, June 8, 1956

"Tubeseal" system developed for sealing floating roof tanks for large petroleum storage tanks. Drawing shows seal at flotation level so there is no vapor space. Description, in details, of ribbed scuff band and tubular seal. 80 ft. dia., 20-200°F. (Tank 80 ft. dia., 36 ft. high butadiene acrylonitrile synthetic rubber and nylon.)

A-160.
Anon.
A Summation Of The Pneumatic High Temperature Seal Evaluation Program
Walter Kidde & Co. Inc., Belleville, N.J., June 12, 1956

Describes a procedure for testing O-rings at 3000 psi pressure and test cycles of 4 hours, as a preliminary selective step, aiding in sample selection for further test.

A-161
Anon.
High Temperature Hydraulic Research And Development Program Status. Report 6
Douglas Aircraft Co., Report No. Dev. 2030, July 1, 1956

Work with Hycar 4021, Acrylons EA5, and BA12, neoprene and nitrile type rubbers has been discontinued. Basic polymer deficiencies precluding their use in high temperature applications are discussed. Compounding studies with Fluororubber IF and Kel-F Elastomer has been continued. Philprene VP-15, Philprene VP-25 and Philprene VPA are of interest, but all of them contain an unsaturated Diene backbone.

A-162
Anon.
Metal Boss Seals
SAE Journal, V. 64, p. 85, July, 1956

Metal boss seals give good service in 3000 psi - 400°F hydraulic systems if the parts they seal are dimensionally accurate. Inaccurate fittings harm seals. Description and discussion. Drawings.

A-163
Anon.
O-Rings May Answer Your Gland Leakage Problems For Valve And Pump Maintenance
Oil and Gas Journal, V. 54, pp. 263-4, July 30, 1956

A-164
Anon.
Elgin A.F.B., Climatic Laboratory Cold Weather Test of Teflon Back-up Rings As Installed In The Hydraulic And Pneumatic Systems Of F7U-3 Airplane Report #1, Final Report
NATC PTR AC-1303.13.1, Naval Air Test Center, Patuxent River, Md., Aug. 1, 1956

This report covers the cold weather evaluation of the teflon back-up ring installed in lieu of the AN 6291 leather back-up ring in the universal fittings of the pneumatic and hydraulic systems down through -65°F.

A-165
Anon.
High Temperature Hydraulic Research And Development Program. Status Report No. 7
Douglas Aircraft Company, Report No. 2030, Sept. 1, 1956

An apparatus for tensile testing of ring specimens while immersed in hot fluids has been designed. Screening test results at 400°F. In addition, a teflon O-ring was run with the same test conditions. These tests were conducted after certain modifications of the screen machine; modifications described in status report No. 1

A-166
Anon.
Seals For Aircraft Gas Turbines
SAE Jour., V. 64, pp. 46-50, Sept., 1956, based on SAE papers 685, 686, 687 and 688, by J.B. Stevevens, J. Palsulich, J. W. Pennington, R.L. Johnson and others in a symposium on High Temperature Dynamic Seals at the Jan. 12, 1956, meeting.

Positive clearance or labyrinth, shaft, bore, and face seals.
Lists problems in main shaft bearing lubrication systems, containing or controlling air flow within proper channels, and sealing accessory drives. Also included is the problem of selecting and designing fluid flow barriers against rotating shafts in gas turbines.

A-167
Anon.
Improved Gasketing Material
Materials and Methods, V. 44, p. 149, Sept., 1956

Discussion of properties of teflon impregnated felt used as a gasketing material.

A-168
Anon.
High Temperature Hydraulic Research and Development Program. Status Report No. 8
Douglas Aircraft Company, Report Dev. 2030, Nov. 1, 1956

Work with Fluororubber SF-4 and Kel-F polybends reported in report No. 6, was continued. Formulas and physical properties for twenty-two additional stocks are presented. Seventeen stocks were prepared by varying the compounding ingredients and modifying the amounts added to the blend of Kel F and SF4. Five compounds are modifications of the time and temperature of cure of three of basic seventeen.

A-169
Anon.
High Temperature Hydraulic Research And Development Program. Status Report No. 9
Douglas Aircraft Company, Report No. DEV 2030, Jan. 1, 1957

O-rings made from five rubber stocks based on Hycar 4021 and 1072, and four polybends of Kel-F-3700 and IF-4 elastomers were turned over to the Propulsion and Mechanical Section for O-ring cycling and chew testing. Rings made from Hycar base compounds are being recycled to see if variations in milling and molding techniques would enhance mechanical performance.

A-170 T
Anon.
Non-corrosive Seal For Shafts
Engineering, V. 183, p. 90, Jan. 18, 1957

"Fluoseal," a mechanical seal for rotating shafts, made entirely of "Fluon." Its use is for sealing acids, strong oxidizing or reducing agents, and organic compounds. Normal range 20 inches vacuum to 50 lbs/sq. in., $-40^{\circ}C$ to $+80^{\circ}$ C.

A-171
Anon.
Improved High Pressure Packing
Tech. News Bulletin N.B.S. 41, 22, Feb., 1957

N.B.S. scientists have successfully used polytetrafluoro-ethylene impregnated with 5% by weight of molybdenum disulfide as a packing material in the high pressure morringseal of differential area pressure intensifiers. Sealed effectively at pressures approaching 200,000 psi. Description and test observations are discussed.

A-172
Anon.
What A Gasket Is And How It Works
Petroleum Processing, V. 12, No. 3, pp. 96-110, March, 1957

Features of confined, unconfined, partially confined, self-confining, and self energizing joints; temperature and nature of fluid or gas as factors in choice of gasket material; materials available; construction of metal gaskets; yield stress; gasket design for special purposes.

A-173
Anon.
Sealing Drives And Anti-friction Bearings
Design News, V. 12, No. 7, pp. 156-7, April 1, 1957

A-174
Anon.
Superfinished Seal Face Cuts Axial Force
Design News, V. 12, No. 8, pp. 30-1, April 15, 1957

By using Alnico-5 for the stationary housing ring and magnetic stainless steel with a lapped carbon sealing face for the shaft ring, a mechanical seal design which eliminates springs has been produced. The stationary ring must be insulated from the magnetic housings, but all inherent disadvantages of springs are claimed to be elminated.

A-175
Anon.
Development Of Coupling Seal Assemblies For Corporal Missile Propulsion System
T & R/GMD ERS 505-19, Firestone Tire and Rubber Co., May, 1957. Dayton, Ohio

A-176
Anon.
How To Install A Packing On Air And Oil Powdered Equipment
Applied Hydraulics, V. 10, pp. 104-109, May, 1957

Installing packings presents certain problems to both the designer and maintenance man.
Tese problems pertinent to O-rings, V-rings, U-rings and cup packings are discussed.

A-177
Anon.
Improved Ring Gasket For API Flanges
Petroleum Engr., V. 29, No. 5, pp. B111-112, May, 1957

New seal ring for API flanges is now higher than conventional octagonal or oval rings in cross section, and is provided with sealing flats on both inner and outer surfaces; outside diameter of ring is slightly larger than ring groove.

A-178
Anon.
Metal Seals Solve Missile Leakage Problems
Aviation Age, pp. 49-51, May, 1957
(Skinner Seal Co.)

Use of Skinner Inconel "X" flexible metal seal.

A-179
Anon.
Testing Packings On A Plane-built Machine
Applied Hydraulics, V. 10, p. 86, May, 1957

A description of a machine designed by the Warner and Swasey Co. of New Philadelphia (an earth-moving equipment co.) for testing piston head and piston packings.

A-180
Anon.
Parker O-Ring Handbook
Parker-Hannifin Corporation, Cleveland, Ohio, Nov., 1957

A-181
Anon.
Sealing Means For Receptacles Containing Metal In Liquid Or Fused State. (Swedish)
British Patent 780,151, and Nuclear Eng., V. 2, p. 538, Dec., 1957

A ring of soft wire laid between flanges of the receptacle is separated from the liquid metal by a cushion of inert gas introduced into a chamber between the sealing means and the interior of the receptacle.

A-182
Anon.
Handbook Of O-Ring And Dyna- seal Packings
Rubber Products Corporation, Dayton, Ohio, 1958

A-183
Anon.
High Pressure Well Head Equipment
Mechanical Engineering, V. 80, pp. 62-68, March, 1958

Design of pressure - energized gaskets for use at very high pressures, ambient temperatures (15, 000 psi working flanges).

A-184
Anon.
Elastomer Seals Hot Fluids
Iron Age, V. 181, p. 103, April 10, 1958

Rubbers compatible with high temperature and fluids are hard to find.
Viton, a development of E.I. DuPont de Nemours and Co. is good from -60° to 350°F and is compatible with solvents, fuels, lubricants, hydraulic fluids, acids and bases.

A-185
Anon.
Viton: Your New Design Material
Power, V. 102, No. 6, pp. 117-119, June, 1958

New DuPont synthetic rubber for service in oils, fuels and solvents at over 400°F, is linear copolymer of vinylidene fluorine by weight; physical, mechanical and electrical properties; most important apprecia-tions include aircraft seals, pump seals, fuel cells, etc.

A-186
Anon.
Cooled Mechanical Seal
Engineering, V. 186, p. 196, Aug. 15, 1958

A mechanical seal that will operate at temperatures in excess of 800°F and pressures up to 800 lbs/sq. in. developed by Flexibox Limited, Nash Road, Trafford Park, Manchester. Normal water cooled jacket.

A-187
Anon.
Proceedings (of the) Joint Army-Navy Air Force Conference On Elastomer Research And Development (No. 5) V. One.
Materials Lab., Wright Air Development (W.P.A.F.B.)
PB1582031, Off. Tech. Ser. 283 p. 42, ref. Oct., 1958

Testing of fluid seals for extreme environments. Evaluation of elastomers in H.E.F. Methods for for studying behavior of elastomers in aircraft fuels at high temperature. O-rings for cylinder liners of diesel engines.

A-188
Anon.
Technical Memorandum No. 8; The Effects Of Nuclear Radiation On Seals, Gaskets And Sealants
Radiation Effects Information Center - Battelle Memorial Inst., Nov. 30, 1958

A-189
Anon.
Universal Ball Bearing Seal
Engineering, V. 187, p. 294, March 6, 1959

A synthetic rubber seal with a steel reinforcement which can be fitted very easily to any standard sized bearing race that has the necessary groove. A distinguishing feature of the new seal is that the lip is "hinged", in effect, by an annular thinning or "waisting" of the synthetic rubber a short distance back from the lip itself.

A-190
Anon.
X-15 - Hydraulic Seals
Aircraft and Missiles Mfg., p. 32, June, 1959

Discussion covering the application of teflon as extrusion barrier for O-rings in the hydraulic system.

A-191
Anon.
High Temperature And Pressure Pipe Connections
The Engineer, V. 207, p. 930, June 12, 1959

Commercially available, two-bolt coupling with "bayonet" seal. Description, photograph. -175°F to +1000°F. Unions for 1/4" to 1 1/4" pipe dia. Two-bolt connections for 1 1/2" to 30" pipe dia.

A-192
Anon.
Magnetic Shaft Seals Gaining Favor
Chemical Engineering, V. 66, p. 69, Sept. 21, 1959

Favorable commentary on magnetic shaft seals; small size, light weight, elimination of adjustment problem of conventional seals. Application of heavy rhodium plate to alnico magnet eliminates corrosion.

A-193 T
Anon.
Shaft Seals For Compressors And Turbines For Gas Cooled Reactor Application
Proceedings of meeting at Oak Ridge National Laboratory, published as USAEC report TID-7604, Dec. 16-17, 1959.

This publication is a record of the papers presented at this conference and the reproduction of recorded dis-cussions.
There are twenty papers in all.

A-194 T
Anon.
Army Gas-cooled Reactor Systems Program - Semi Annual Report
Aerojet-General Nucleonics Report, Jan. 1 - June 30, 1960

Gas-buffered labyrinth type seals employed on the lubrication system of two-turbine compressor unit designs.

A-195 T
Anon.
Investigations Of Types Of Seals For Main Coolant Pumps For Large Pressurized Water Reactor Nuclear Plants
Ebasco Services Inc., Report NYO-9321, June, 1960, U.S. Atomic Energy Commission, Contr. No. AT(30-1)-2547, 80 pages

Report on study results of the comparative reliability and installed and operating cost of canned-motor and controlled leakage pump designs for application in a pressurized water reactor installation today. The scope and adequacy of research and development programs on seals leaves much to be desired.

A-196
Anon.
Sealing Against Pressure And Vacuum
Chem. Eng. V. 5, pp. 652, 654, 656, 658,
Sept. 1960

Reviews are given of several papers concerning sealing application in pressure and vacuum systems.

A-197
Anon.
Teflon O-Rings Fine New Uses As Both Dynamic And Static Seals
Power, V. 104, p. 249, Dec., 1960

A short article on the advantages, use, properties, and characteristics of teflon O-rings

A-198 T
Anon.
Compressed Air And Gas Handbook, Third Edition
Published by Compressed Air and Gas Institute, New York, 1961

This reference book is a practical handbook on all phases of industrial gas compressors and compressed air powered portable tools and rock drills used in industry. Pages 3-46 through 3-50 contain a description of the commonly used compressor shaft seals. Included are soft packings, labyrinths, restrictive rings, seals, liquid film seals, and mechanical film seals.

A-199 T
Anon.
Evaluation Of Helium Seal Selected For Nuclear Coolant Compressors In Gas Cooled Power Reactor Res. & Dev. Program
Allis Chalmers Manufacturing Co., Jan., 1961

Final report covering development and test work on the floating-bushing buffered shaft seal designed for the Experimental Gas Cooled Reactor project.

A-200
Anon.
Rubber Pump Wall Is Seal And Spring Too
Product Engineering, V. 32, No. 2, pp. 60-61, Jan. 9, 1961

This multi-purpose ring eliminates costly machining in fuel injection pump. Speed of the engine and manifold pressure set correct fuel-flow rate for any load.
Synthetic rubber ring combines three functions: 1) seals pump cylinder with no need of expensive machining; 2) serves as a spring to keep plunger roller follower in contact with cam; 3) pumps fuel when compressed by plunger.

A-201
Anon.
The Seals Book
Machine Design (Spec. Issue), pp. 1-136, Jan. 19, 1961

Handbook to aid design engineers in selecting and applying seals, packings, and gaskets.
Chpt. 1 - Introduction
2 - Felt Radial Seals
3 - Radial Positive-Contact Seals
4 - Exclusion Devices
5 - Clearance Seals
6 - Split Ring Seals
7 - Axial Mechanical Seals
Chpt. 8 - Circumferential Seals
9 - Simple Compression Packings
10 - Molded Packings
11 - Diaphragms
12 - Nonmetallic Packings
13 - Static O-Ring Seals
14 - Metallic Gaskets

A-202
Anon.
Composite Metals Form Static Seals
Chemical and Engineering News, V. 39, p. 56, Feb. 20, 1961

Armour Research Foundation is swinging into final development of a static seal that will take pressure cycling from 0 to 5000 psi, at temperatures to 1500°F. The seal will probably be a composite of two metals; one hard, one soft - since work so far at ARF in developing seals that will take these pressures up to 1200°F has gone in this direction.
Description: Frame & filler technique. Molybdenum, stainless steel, silver, indium/silver alloy.

A-203
Anon.
Precision Upgrades Oil Seal Performance
Steel, V. 148, No. 9, pp. 132-133, Feb. 27, 1961

Some recommendations resulting from a three year study program of seals and packings. Particularly application of lip seals.

A-204
Anon.
Fiber Metal Passes Tests In Seals And Gaskets
Steel, V. 148, p. 136, March 13, 1961

Composite materials that combine the desirable characteristics of their components are said to be suitable for static seals at temperatures up to 1200°F, and pressures to 5000 psi. The materials are also being tested in dynamic seal applications. Resilience of skeleton combines with filler conformability, providing an effective seal for most static, high temperature, high pressure applications.

A-205
Anon
Fiber Metal Seals Take 5000 Psi, 1200°F
Materials in Design Engineering, V. 53, p. 17, April, 1961

Experimental static seals have been made by impregnating strong fiber metal skeletons with soft metal fillers; Armour Research Foundation for W.A.D.C.
Short descriptive article.

A-206
Anon.
Petrol Pump Has Viton Seals
Engineering, V. 191, p. 475, April 7, 1961

First-class solvent resistance and dimensional stability are two reasons for choice of Viton rubber in new British-made petrol dispensing pump, says Du Pont.
Operational results are described.

A-207
Anon.
Metal Fiber Seals
Engineering, V. 191, p. 475, April 7, 1961

Short description of high-temperature high-pressure static seals, developed for the Air Force, made by impregnating a porous body of fibre metal skeleton with a soft metal (Armour Research Foundation). Molybdenum fibre and silver. Pulsating pressures 0 - 5000 lb/sq. in. at 650°C. Brief test, result discussion. By Republic Aviation.

A-208
Anon.
Wire Vacuum Seals
New Scientist, V. 10 (230), p. 37, April 13, 1961

A high vacuum system that makes use of aluminum wire gaskets in place of conventional rubber seals makes it possible, it is claimed, to achieve a ten-thousand fold reduction in pressure. The seal is made secure by placing the wire gasket between steel flanges and heating the joint to about 260°C. Frictional rubbing then occurs owing to the expansion of the gasket.

A-209
Anon.
Research Attacks Seal Leakage; Three Step Approach Unveils Failure Causes
Iron Age, V. 187, pp. 72-74, June 1, 1961

Considerations in the research. Discussion and data.
1) Lip Seals 4) Joules effect
2) Shaft surface 5) Trim interference factor
3) Torque factor 6) Raw materials
Description of "Sealactor" testing machine

A-210
Anon.
Performance Of Some Modern Gasket Materials
Mechanical World and Engineering Record, V. 141, pp. 208-210, June, 1961

The range of modern gasket materials available provides ample scope for choice of compressibility sealing pressure, physical performance and chemical inertness. The basic factors governing the performance and selection of resilient seal materials and the properties of some typical modern compositions are given.

A-211
Anon.
Atomic Reactor Uses Silicone Rubber Seals
Rubber World, V. 144, p. 106, June, 1961

A-212
Anon.
Mechanical Seal For High Speed Shafts
Engineer, V. 211, p. 916, June 2, 1961

Face-type balanced multi-spring design. For applications with restricted axial space. For peripheral speeds to 15,000 fpm, pressures to 1000 psi and temperatures to 500°F.

A-213 T
Anon.
Pumps For Water-cooled Power Reactors
Nucleonics, V. 19, No. 7, pp. 55-63, July, 1961

Describes reactor system pumps in use or planned. Also brief summary of AEC seal development programs.

A-214
Anon.
Eight Instrument Seals
Product Engineering, V. 32, pp. 84-85, Sept. 18, 1961

Sketch, and three-line description of each of eight seals for instrument cases. Besides keeping water and dirt out, they must also strengthen the rim of the instrument case.

1) Offset 2) Extrusions 3) Flange 4) O-Ring
5) Bead 6) Space Saver 7) Tubular Extrusions
8) Chevron

A-215
Anon.
Speciality Rubbers For Special Uses
Chemical Engrg., V. 68, pp. 204, 206, 208, Sept. 18, 1961, and pp. 132, 134, 136, Oct. 2, 1961

Design information for gaskets and seals made from the new heat and chemical-resistant elastomers. These include Viton, Hypalon, Fluorel 2141, Kel-F, and various silicone rubbers. A table of their resistance to various solvents and corrosive chemicals is added.

A-216
Anon.
Tube Connections, A State Of The Art Survey: Flanges, Seals, And Joints
Report No. 1058, Chrysler Corporation Missile Division, Huntsville Operation, Oct. 20, 1961

IG Pneumatic Test of soft material sealed flared fittings. Flange, seals, and joints (pp. 131-188). Seal materials; seals for V band coupling flanges; helium seals.
Temperature - energized seals for liquid hydrogen; pressure energized seals; high temperature hydraulic seals; seals for hot gas servo systems.
Appendix II. Misc. reports on O-rings and sealants.

A-217
Anon.
Pumps
Lubrication, V. 48, pp. 17-32, Feb., 1962

Liquids which constitute a large portion of this planet are conveniently moved by means of pumps.
Many general purpose and special pumps are described. Among the latter are jet pumps, gas lift pumps, hydraulic ram, electromagnetic and canned pumps. Stuffing boxes or mechanical seals are used on many of these pumps and they are discussed. Electromagnetic or canned pumps have no seals. The pumping action is obtained by electromagnetic means, either direct or indirect, depending upon whether or not magnetic or non-magnetic fluids are being pumped.

A-218
Anon.
Magnetic Shaft Seals
Engineering, V. 193, P. 260, Feb. 23, 1962

The seals consist of a magnetized ring with a sealing surface fixed in a stationary manner to the housing, and a second ring also with a sealing surface coupled to the shaft by means of an O-ring. This second ring moves axially along the shaft in response to strong magnetic attraction, firmly engaging the first ring. Sealing surfaces are held in contact by magnetic forces when no fluid pressure exists and eliminates a troublesome spring.

A-219
Anon.
Sticky Vacuum
Time, p. 51, April 13, 1962 (National Res. Corp.)

Seals, materials

A-220
Anon.
Magnetic Particles Seals
Mech. World, V. 142, pp. 172-3, June, 1962

Flexible membrane consisting of finely divided iron particles suspended in oil and constrained in air gap by magnetic field can be used as efficient shaft seal for stationary, rotating, or reciprocating actions.

A-221
Anon.
User's Comments On Rubber/Metal Gaskets (Hyclad, Made by Fireproof Tanks)
Engineering, V. 194, p. 50, July 13, 1962

A gasket material of metal sandwiched between layers of rubber has proved itself able to withstand abuse and to seal difficult joints. Consists of 26 swg aluminum sheet (L 72) sandwiched between two layers of nitrile rubber. Aluminum can be varied from 12 to 30 swg.
Sealing electronic equipment; integral fuel tanks; washers for "all metal" couplings; flameless pipe couplings. Discussion of application and drawings included.

A-222
Anon.
Rubber O-Rings For Automotive Seal And Packing Applications (Reprint from SAE Handbook)
SAE paper, H.S. 212, September, 1962.

A-223
Anon. (French Patent 1,260,206), Mar. 27, 1961
Removable Fluid Tight Closure Means For A Hole Provided In A Wall Separating Two Fluids, In Particular Inside A Nuclear Reactor
Nuc. Sci. Abst. 28500 (V. 16, No. 20, p. 3726, Oct. 31, 1962).

Closure piece inserted into the channel forming the hold, so that the force presses sealing surfaces of the closure pieces against sealing shoulders provided in the wall and in the closure piece.

A-224
Anon.
A Gasketless Joint For Application To High Temperature, High Pressure Water Systems
Naval Research Lab., Nov. 4336, AD 27384

Describes development of a joint with a metal gasket. Single profile type.

A-225
Anon.
Design Data For O-Rings And Similar Elastic Seals Part 2
WADC-TR 56-272, Boeing Airplane Co., Seattle, Washington

This study is to gain knowledge of the relationship between the physical properties of seal materials and sealing efficiency so that materials may be fully utilized in seal design. Commercially available polymers have been compounded with various physical properties. Static annulus, rotating shaft, and reciprocating shaft functional test jigs have been designed and manufactured. Seals tests have been run in these jigs.

A-226 T
Anon.
Dynamic Sealing: Theory And Practice
Koppers Company, Inc., Metal Products Division, Baltimore, Md.

This booklet is a collection of six papers on dynamic seals, showing the application of the basic equations of fluid mechanics to the problems of sealing; discussion of labyrinth seals, clearance seals and split ring seals. Typical applications and performance data are presented.

A-227
Anon.
Radial Sealing Rings: Shaft Packings
(Trans. of Verein Deutscher Ingenieure, Zeitschrift, West Germany, V. 97, No. 7, pp. 226-230) S.L.A. Translation 59-20843

A-228
Anon
Rubber Packing, Or Joints, For The Conning Tower Hatchway Cover
PB 46381, Off. Tech. Ser., 2 pages

A cross sectional drawing of a water-tight rubber seal and fitting for a conning tower hatchway cover is shown.

A-229
Anon.
Standard Flange Seal
Raco Engineering

Standard Flange Seal

A-230
Anson, D.
A Mechanical Seal For Very High Pressures
J. Sci, Instr., V. 32, p. 446, Nov., 1955

A piston seal is described and illustrated for use up to 15,000 Atm. of pressure with alc. as the working fluid.

A-231
Apkarian, H.
Gas Leakage Tests On Shaft Seals
R49GL74, GEL Tech. Data Center, G.E. Co., Sch'dy, N.Y., 14 pp., Oct. 26, 1949

Progress report on two types of rotary shaft seals. The seals tested were a face type seal and one was an original design. Tests run on 5/8" shaft over a range of speeds and duty cycles. Evaluation based on gas leakage rates while varying time, speed, and duty cycles.
Several types tested. Best double face type seal with water circulated through it. Leakage rate less than 1CC per year.

A-232
Apple, F. C.
Leakage Of Water From Valve Stuffing Boxes
U.S. A.E.C. Res. & Dev. Report D.P 538, 12 pp., 6 Fig, Jan., 1961

A-233 T

Asanuma, T.
Study On The Sealing Action By Viscous Fluid (In Japanese)
Trans. Japan. Soc. Mech. Engrs., V. 17, No. 60, pp. 119-125, 1951

For the purpose of obtaining a sealing method of rotary shaft penetrated into a vacuum, or high pressure vessel, the author proposes to prevent the leakage by viscous fluid which has a very high pressure due to the pumping action of the rotary shaft with a helical screw groove. In this paper he studies theoretically the pump performance under the laminar theory and it is clear that to obtain the maximum pump efficiency, some dimensions of the screw groove are to be selected as follows:
a) the width of the thread to be as narrow as possible
b) the ratio of width to depth of the groove should be equal 5-10:1
c) the ratio of a gap to the depth of the groove should be 0.1-0.2:1
d) the helical angle of the screw thread to be about 10-20 degrees.

A-234 T

Asanuma, T.
On The Flow Of Liquid Between Parallel Walls In Relative Motion (In Japanese)
Trans. Japan. Soc. Mech. Engrs., V. 17, No. 60, pp. 140-146, 1951

The author discusses some theoretical formulae for the turbulent flow through a fine clearance space (δ) between two parallel walls, one of them being in relative motion to the outer at arbitrary angle to the direction of the pressure gradient. Therefore he applies this formula to the flow through the annular space formed by two concentric pipes in relative rotation, and then obtains an empirical formula for the turbulent flow in such a case using the experimental data of R. J. Comish.

A-235 T

Asanuma, T.
Studies On The Sealing Action Of Viscous Fluids
Int. Conf. on Fluid Sealing, paper A3, 21 pages, British Hydromechanics Research Assn., April, 1961

An extensive report on the theoretical and experimental study of the screw viscosity pump when considered as a seal.
In Part I - the pumping and sealing performance of screw pump having various thread or groove forms are treated theoretically in effort to ascertain the most desirable design geometry. Also, the confirming experimental data and conclusions, using mineral ore and grease.

A-236

Ashmead, R. R.
Static Seals For Missile Applications
Jet Propulsion, pp. 331-340, July, 1955

Excellent general discussion of seals and sealing problems. Seals are classified as: (1) plastic, (2) rubber O-ring, (3) expanding seal compounds, (4) soft and flexible metal.

A-237

Asp, H.
How Teflon Packings Behave Where Temperatures Vary
Applied Hydraulics, V. 10, pp. 127-132, May, 1957

Teflon has a low coefficient of friction and excellent properties over a wide range of temperatures. However, its thermal expansion and shrinkage, where temperature variations are 100°F or more, can cause leakage. A production technique is described which controls this.
The result of the application of this technique are "memorized" packings.

A-238 T

Aspelin, L.L.
Shaft Seal For Alternate Wet And Dry Operation
U.S. Patent 2,957,711, Oct. 25, 1960

A shaft seal for use where it is desirable to maintain continuous shaft rotation under the intermittent presence and absence of a sealed fluid. The pressure of the sealed fluid maintains sealing contact while the fluid acts as a lubricant. When the fluid pressure is removed, sealing contact is no longer obtained and wear does not occur.

A-239 T

Atkins, B.R., Bradshaw, J.R., Mitchell, P.J.
New Carbon Materials For Mechanical Applications
Int. Conf. On Fluid Sealing, Paper F3 (8 pages)
British Hydromechanics Research Association, Harlon, Essex, England, April 1961

Description of a series of molded carbon products containing various additives such as polytetrafluroethylene, and molybdenum disulphide. These products are designed for applications in which normal lubricants fail or are absent. Some physical properties are listed, i.e., thrust ring, experimental apparatus seal, medium of air. Thrust 12 lb/sq in, stator cast iron, 600 hour run, alternate material 60 hour run.

A-240 T

Atkinson, R. P.
Piston Ring Turbine Shaft Seal
U.S. Patent 2,812,196, Nov. 5, 1957

A split piston ring, contained in a groove on a rotating shaft sleeve, made to spring against a stationary sleeve. The split in the ring is inclined outward with rotation of the shaft, so that oil attempting to flow inward will be picked up in the ring gap and forced outward. A visco seal of short length.

A-241

Atkinson, W.B.
Gasket Materials For Electrical Equipment
Prod. Engrg., V. 20, pp. 124-127, Dec., 1949

Eleven types of gasketing material suitable for electrical equipment. General advantages and disadvantages of each type. Joint design using cork-neoprene, rubber bonded asbestos, and others.

B-001
Babb, S.E.
Combined Bridgman and O-Ring Static Pressure Seal
Rev. Sci. Intr., V. 31, p. 219, 1960

A seal adopted for use in high-pressure applications up to 12,000 atm. The seal assembly is illustrated and consists of an extrn. ring, O-ring, Teflon back up ring, and an unsupported area seal ring.

B-002
Bailey, E.C., Schroeder, H.C., Carlson, D.H.
Operating Experience with Mechanical Joints in High-Pressure High Temperature Steam Piping
A.S.M.E. Transactions, V. 75, pp. 97-101, Jan. 1953

Two types of mechanical transition joints were installed at the Ridgeland Station of the Commonwealth Edison, Chicago, Ill. The joints, pressure seal and bellows type, were designed for operation on steam at 1800 psig and 1050°F.
The pressure seal joints have been in service one year and five months, the bellows type joints one year.
Pressure joint seal - gasket soft steel, silver plated.
Bellows type seal - gasket cobalt base alloy L-605.
Photos, drawings, test curves data included.

B-003 T
Bailey, J.F.
Analysis and Design of the Frozen Seal
Oak Ridge National Laboratory, Report No. ORNL 2110, Feb. 12, 1957

Theoretical and applied aspects of a seal in which the liquid whose leakage is to be prevented is frozen to form its own seal. A frozen sodium pump seal is used as an example.

B-004
Bailey, J.F.
Analysis and Design of the Frozen Seal
Oak Ridge National Lab., Tenn. ORNL-2110 Contract NO W-7405-eng-26, 11 pp., March 8, 1957

B-005
Bailey, J.M., Swikert, M.A., and others
Wear of Typical Carbon-base Sliding Seal Materials at Temperatures to 700°F.
NACA TN 3595, Feb. 1956, 22 pp.

Wear and friction studies were made to show the effects on performance of temperature, type of mating material, and minor composition changes in typical carbon seal materials. Most data were obtained at a surface speed of 10,000 feet per minute, a load of 1000 grams on a 3/16 inch-radius specimen, and temperatures to 700°F.

B-006
Baker, D.
An All Metal High Vacuum Valve
Vacuum, V. 12, pp. 99-100, March/April 1962

Valves which employ a knife edge seal have been developed which offer significant advantages compared with other types of all metal valves. A low initial closure torque of 2.5 lb-ft. for a valve of 2.5 cm operation has remained unchanged after 3000 operations without measurable increase in the closed conductance of $< 10^{-14}$ 1/sec. Since closure torque is directly proportional to the valve aperture, the design may be used for large apertures. (Copper gaskets and knife edge seal)

B-007
Baker, J.R.
Steam Turbine Shaft Gland
Power, V. 53, pp. 881-3, May 31, 1921

Why packing is necessary
Carbon ring packing seals in the shaft glands
Labyrinth packing
Drawings and pressure loss data curves.

B-008
Ball, W.P., Cheyney, L.E., and Clark, F.E.
Molding of O-Ring Packings
Rubber Age (N.Y.), V. 62, pp. 652-4, 1948

A newly developed method for testing the phys. properties of O-ring hydraulic packing is described and illustrated.

B-009
Ballif, J.L.
A High Vacuum Application of Inflatable Seals for the Processing Refabrication Experiment
Atomics International Div., North American Aviation, Inc., Canoga Park, Calif., NAA-SR-2544, Contract AT-11-1-GEN-8, 47 pp., Jan. 15, 1959

A method was developed for sealing the massive shielded doors of the vacuum access lock in the PRE cell complex with inflatable rubber seals of the type used by the aircraft industry. Leak rates of less than 1 ft^3/day were maintained.

B-010
Bannock, R.R.
Molecular Sieve Pumping
Vacuum, V. 12, pp. 101-106, March/April 1962

Details of demountable flange seal. In principle a compressible double knife-edge ring is clamped between the two flanges with 10μ copper washers between the knife-edges and the polished flange faces. Five screws are used to clamp the flanges together. The elasticity of the knife-edge ring maintains the vacuum-tight seal over a wide range of temperatures (-196°C to 500°C).

B-011 T
Barbouv, R.J., Isenbarger, R.O.
Fluid Seals
SAE Paper No. 467, March 1-3, 1955, 4 pp., also - Machine Design - V. 27, No. 12, pp. 214-6, 218, Dec. 1955

Conditions which a lip seal must withstand not only affect the design, but also determine the choice of material from which the seal is made. Effects of pressure and speed on lip-type shaft seals, comparison of various synthetic rubbers with leather, and causes of failure are three areas of discussion. Sealing problems in hydraulic applications, and automotive applications are the main topics discussed.

B-012
Bargh, K.A.
Teflon Sheet as a Large-area Gas Seal for Gas Flow Radioactivity Counters
Rev. Sci. Instr., V. 29, pp. 536-7, June 1958

A flexible sealing material to confine the flow of the counting gas. A plastic foam sheet covered with a 0.006 inch layer of teflon self-adhesive sheet was found very suitable.

Preceding page blank

B-013 T
Barnes, G.C., Ryder, E.A.
Progress Report on Rubbing Seals
S.A.E. Paper No. 46, 11 pp., Jan. 1957

A seal test rig, using easily procured test pieces has been devised to provide a fast rough screening test for materials that might be used for rubbing seals in aircraft gas turbines. The test rig is designed to determine dry load carrying capacity of pairs of material and to approximate wear rates and temperature limitations of compatible mating surfaces.

B-014 T
Barrett, T., English, D., and others
Improvements in or Relating to Shaft Seals
Great Britain Patent 827,015, published Jan. 27, 1960

Viscosity groove type shaft seal to provide against the leakage of pressurized gas by means of a liquid such as oil. The design is claimed to be applicable to plate type and cylindrical type seal designs.

B-015
Barton, D.M.
Vacuum O-Ring Seals
Vacuum, V. 3, No. 1, pp. 51-53, Jan. 1953

A new groove design for use with O-ring seals. Groove has trapezium cross section, with parallel edges perpendicular to the sealing face to provide suitable retention of the O-ring while position and inclination of the groove base controls both, required compression and cross sectional area. Drawings and design data included.

B-016 T
Barwell, F.T.
Research on Friction and Wear
Instn. Engrs. and Shipbuilders in Scotland, V. 95, part 2, pp. 64-91, 1951-52. Also Engineering V. 172, pp. 649-651 - Nov. 23, 1951, pp. 697-699 - Nov. 30, 1951

Experiments carried out in Thorntonhall Laboratories reveal that eccentricities have no noticeable effect on formation of vortices. Therefore G.I. Taylors' theory may be applied directly to an eccentric bearing.

B-017
Bashta, T.M.
Design of Seals for Rotary Type Hydraulic Machine Sets

(Voprosy Konsruirovaniya Uplotneii Gidravlicheskikh) Agregatov-Vrashchatelnikh Tipov, Aug. 60-13 pp. RTS 1145 LC or S.L.A.-translation 60-23793

B-018 B
Baskey, R.H.
A Research Programme on the Investigation of Seal Materials for High Temperature Applications
W.A.D.C. Tech. Report 58-181-74, pp. 12, ref., June 1958, (P.B. 151451) (Preprint 59LC-8, A.S.L.E., 5 No. Wabash Ave., Chicago 2, Ill.)

Novel rotating seal materials were developed by powder metallurgy techniques for potential aircraft applications at high speeds and high temperatures. A systematic wear study without lubrication included several commercially available materials, also pure refractory hard metals, binary alloys.

B-019
Bass, H.G., Fischer, W.W. (G.E. Co., Sch'dy.,N.Y.)
Estimation of Transient Temp. of Nose Door Seal H.A.-3B
PB 145-917 - Off. Tech. Ser., 3 pp., Oct. 6, 1952
(Hermes Heat Transfer Memo. No. 53, declassified)

The object was to estimate the during-flight temperature of the rubber seal of the nose doors for the H.A.3B missile. No attempt is made herein to determine the overall satisfactoriness of the design investigated.

B-020 T
Baudry, R.A.
Gland Seal for Rotating Shafts
U.S. Patent, 2,246,912, June 24, 1941

Shaft seal, for use on a hydrogen cooled machine, is accomplished by injecting sealing oil around solid sealing rings which fit close to the shaft. The oil supply and gland operation prevent low pressure regions from occurring in the seal clearance space, and air is not sucked into the seal.

B-021
Baudry, R.A., Winer, B.B. T
Gland-Seal Bearings for Gas-Cooled Equipment
U.S. Patent 2,501,304, March 21, 1950

A combination bearing and seal for use on gas-cooled machinery. Lubricant is injected in an annular groove behind a self-centering sealing ring. Most of the lubricant flows across the bearing to the air side, while a much smaller quantity is diverted by the sealing ring to the gas side.

B-022 T
Baudry, R.A.
Seal for Hydrogen Cooled Generators
U.S. Patent 2,636,754, April 28, 1953

A system designed to substantially reduce the amount of make-up hydrogen required in the hydrogen cooled machines. A small amount of hydrogen is bled off the hydrogen side of the gland seal and is used to remove air and moisture from the air-side oil before the oil is recirculated through the seal. This reduces the amount of air entering the machine, making the hydrogen make-up requirements less.

B-023 T
Baudry, R.A., Winer, B.B.
Journal and Thrust Bearing Practice on Large Rotating Electric Machines
Lubrication Engng., V. 10, pp. 327-335, Dec. 1954

Bearings used on electrical machines must have very effective oil seals to prevent oil mist from passing into the machines. Slow speed machines can use simple felt seals, but high speed machines require a more elaborate sealing system. The author describes a double labyrinth oil seal which uses a split flow of air to prevent leakage of oil mist into the machine.

B-024
Baudry, R.A. and Curtis, L.P.
Gland Seal Systems for Modern Hydrogen Cooled Turbine Generators
AIEE Trans., Power App. & Sys., V. 76, pp. 328-337, June 1957

With the advent of hydrogen pressures above 30 psig made possible by inner cooling of the coils, a reevaluation of the gland seal design was indicated. This paper covers such a development.

B-025
Baudry, R.A., Peterson, G.E., and others
Oil Seals to Provide Positive Lubrication on Large or High Speed Thrust Bearings
ASME Trans., V. 80, pp. 819-825, May 1958

Paper discusses the application of positive oil seals which effectively prevent aeration of the oil and oil leakage.
Paper concludes that proper application of laminar fluid seals at the bore and periphery of the thrust-bearing runner, and the maintenance of positive pressures at these seals effectively prevent aeration of the oil in large and high-speed thrust bearings, thus assuring adequate lubrication. Discussion follows paper.

B-026
Baumann, R.
Pressure Tests with Vulcanized Fiber, Ebonite and Metal for Stuffing-box Packing. (In German)
Zeit des Ver deutsches Ing., June 1913

Description of tests and their results.

B-027
Baumbach, W.
Stuffing Boxes for Agitators
Brit. Chem. Eng., V. 3, pp. 89-90, 1958

A description of three new types of stuffing boxes used for shaft sealing in chemical vessels fitted with agitators
(1) Stuffing box with plain bearing attached
(2) Stuffing box with outrigger bearing
(3) Extended stuffing box.

B-028
Beacham, T. E.
Rotary and Oscillating Seals
IME Proc., V. 160, pp. 532-536, 1949

Several types of seals, e.g., soft packings, rubber seals, metal-to-metal, metal-to-carbon, journal seals, face seals, etc. are discussed.

B-029
Beacham, T.E., and Towler, F.H.
Hydraulic Seals
IME Proc., V. 160, pp. 532-569, 1949

Presents a detailed account of rotary, oscillating and reciprocating seals; materials normally used in each, and operating conditions.
Purpose of paper an initiation of a comprehensive discussion of existing knowledge on subject.

B-030
Beacham, T.E.
Rotary and Oscillating Seals
The Engineer, V. 187, pp. 228-229, Feb. 25, 1949

Automatically adjustable shaft seals. This includes cross-sectional views of ten metal and carbon face seals. For use with high-speed shafts, they are suitable for particularly difficult sealing problems; diagrams.

B-031 B
Beakbane, H.R.
Leather Seals for Hydraulic and Pneumatics
Proc. 2nd European Jl. Pür. Conf., pp. 14-22, April 1960

Use of leather may be considered a little old fashioned, but for many purposes it is superior to other materials. The paper considers the properties of leather, with regard to resistance to heat and power fluids, its qualities when impregnated with various waxes and resins, and the effect of corrosion.

B-032 B
Beatty, J.R., Juve, A.E.
Stress Relaxation of Some Rubber and Synthetic Rubber Vulcanizates in Compression
India Rubber World, V. 121, 5. pp. 537-43, Feb. 1950

B-033
Beck, E.C., and others
Designing Seal Rings for Today's Car Transmissions
SAE Journal 70, 71-2, Feb. 1962 (Based on SAE paper 475E)

Physical properties and stress limitations of the material used control design of a sealing ring to a great degree.
Discussion: Cast Iron - mean stress 30,000 psi, max. 55000 psi; Aluminum - mean stress 25,000 psi, max. 40000 psi
Operational problems, including an eleven point check list, and wear compatibility of carrier, bore, and ring.

B-034
Becker, E.
Flow Processes in Annular Gaps (Labyrinth Seals)
Translated for Oak Ridge National Lab., Tenn. from VDI Zeitchrift, V. 51, pp. 1133-41, July 20, 1907. (AEC-TR-4960)

Turbulent flow processes in annular gaps having irregular cross sections are studied with particular references to labyrinth seal applications.

B-035
Becker, Reinhard
O-Ring Seals in Hydraulics
Microtecnic, V. 12, pp. 289-290, Oct. 1958

A reliable hydraulic construction depends on long lasting sealing material. This in the face of high stressing by variable pressure, high or low temperatures and the most varied kinds of movements.
O-rings are recommended for the above mentioned requirements.
Applications up to 350 Kg/cm^2 are possible as well as for a high vacuum.
For all moving part seals, material of 80-90 scleroscope units of hardness is used. If little or no lubrication is present graphite O-rings are used.

B-036
Beecroft, R.I. and Swenson, C.A.
Behavior of Teflon Under High Pressures
J. Appl. Phys., V. 30, pp. 1793-8, 1959

Compression measurements have been made on samples of Teflon at various temps. 75-380°K, and at pressures up to 21,000 atm.

B-037
Bell, H.F.
Automatic Detection of Pump-seal Failure
Oil and Gas Journal, V. 54, pp. 169-170, Oct. 10, 1955

B-038 T

Bell, K.J., Bergelin, O.P.
Flow Through Annular Orifices
Trans., A.S.M.E., V. 79, pp. 593-599, 1957

Summary of the results of an experimental and analytical investigation of orifice coefficients. The theoretical results, derived in a thesis by Bell, are restated for eleven cases, including laminar, transition, and turbulent flow for various types of annular orifices. Experimental results are presented in graphical form.

B-039

Bell, M.
Improving Packing Performance
Power Plant Engineering, V. 40, pp. 726, Dec. 1936

Application of a split ring, around a valve rod, under the follower, to allow greater compression on the valve packing.

B-040

Bell, M.
Solution of all Packing Problems
Power Plant Engineering, V. 40, No. 121, pp. 710-11, Dec. 1936

Explains the technique and use of three items for packing problem solution. Joint paste, made principally of manganese; a sheet of fine gauge wire; a can of shredded metallic gland packing.

B-041

Benjamin, C.H.
Friction of Steam Packings
Mech. Eng., V. 4, pp. 838-839, Dec. 9, 1899

The experiments described in this paper were made at the Case School by senior students under direction of the writer.
Test equipment, data, and results presented.
Soft rubber, graphite, dry and lubricated were used with various pressures.
The loss of power varies almost directly with the steam pressure in harder varieties of packing, but is nearly constant with softer kinds.

B-042

Bentley, F.W.
Pneumatic Cylinder-Packing Leathers
Power, Oct. 7, 1913

Illustrates directions for replacing pneumatic cylinder packing, showing defects resulting from some methods employed.

B-043

Berens, A.S.
New Elastomer - Impregnated Leather Gives Complete Porosity Control in Sealing Applications.
Materials and Methods, V. 38, p. 127, Oct. 1953

A continuing problem in leather seals has been control of porosity. Performance tests on a new elastomer impregnated leather, called Conpor, indicate porosity control has been accomplished. Properties of this new product are discussed.

B-044

Berg, R.J.
A Review of Seal Materials for Guided Missile Applications
California Inst. of Tech., Jet Propulsion Lab., JPL-PR-20-340, Contract DA-04-495-Ord-18, March 7, 1958

The currently available seal materials which have proved useful in guided-missile applications are described. A summary is presented in tabular form, of the results of experience with various seal materials.

B-045 B

Bergholm, A.O., and Swartz, P.W.
Sealing Action of Packing Rings
J. Franklin Instn., No. 253, pp. 253-6, March 1952

Determination of the manner in which pressure is transmitted through V-ring packings. Photographs of stress patterns.

B-046

Berk, S.
Fungicidal Treatments for Cork Gaskets
Ind. & Engng. Chem., V. 41, pp. 627-633, March 1949

Seven fungicidal formulations applied to protein and resin bonded cork were evaluated on the basis of a number of criteria for moldproofing automotive gaskets.

B-047

Bertolet, E.C., Jr.
Use of Teflon Packings and Seals in Hydraulic Operations
National Conference of Industrial Hydraulics, V. X, pp. 56-68, October 18, 19, 1956

Presents physical properties of Teflon; Hydraulic application as gaskets, packings; "Vee" and "U" types "L" cup, flange packings, and piston rings. Describes their performance. Test results are discussed.

B-048

Bethel, C.
Waste-packed Bearing Design and Operation
Elec. Jl., V. 21, pp. 115-8, March 1924

Information regarding oil flow and action of waste packing.

B-049

Beyer, K.
Joint Packings for Pipes
Arch. f. Warmewirtsch, 16, pp. 123-126, May 1935

The choice of suitable materials for insertion as packings in the flange joints of pipes is of importance in preventing operational troubles and leakage losses. Various types of packings are described, and an analysis is made of the materials available, and the pressure and temperature limits within which they can be employed for pipes carrying water, steam, air, and oil.

B-050

Bialkowski, L.S. and Le Blanc, J.
Metallic Seal Design for Advanced Systems
SAE-Paper 523B for meeting April 3-6, 1962

All-metallic seal produced by B.F. Goodrich Co. is adapted for rod or piston service, dynamic or static applications, and operates successfully at -65 to 500°F, pressure to 35,000 psi, concept is that of blunt knife edge that forms radial or axial edge of flexible diaphragm.

B-051
Billet, A.B.
High Temperature Sealing Studies of Missile Hydraulic Components
SAE paper 50T from meeting of Mar. 31, 1959, 10 pp.

Environmental requirements for static and dynamic seals used in guided missiles and manned aircraft for outer space; shaft and static seal development; use of silicone and Viton A appears to give best sealing characteristics in 400 to 550 F range to date; seals for hot gas servo systems; examples of applications, such as actuator, servo valve, dual pump, and miniature vane pump.

B-052
Billet, A.B.
High Temperature Hydraulic Pump Seals
Machine Design, V. 31, p. 152+, Oct. 1, 1959

Describes one of the major areas of development in high-temperature hydraulic sealing studies, that of the dynamic seal of the unit drive shaft. (Viton A - lip type radial shaft seal. 400°F/100 hrs. Glass - Teflon filler, carbon-rubber surface with Viton A static O-ring) Static seal development, fluid compatibility, seals for hot servo systems, also discussed.

B-053 T
Billet, A.B.
Hydraulic Seals in Long Term Space Exposures
International Conference on Fluid Sealing-paper G2, April 1961, British Hydromechanics Research Association, Harlow, Essex, Eng.

This paper discusses the effects of long time exposure of combined space environment on hydraulic sealed systems and component. Test results of dynamic seal elements operated successfully at 1000 psi, 2000 ft/min. surface speed for 20 hours. High temperature sealing ranges from 400°F to 1000°F.
Static seals - 300°F to 500°F Hot gas sealing 2200 psi at 2000°F
Gamma dose - 4.5×10^5 R, natural radiation 5.5×10^{14} N TV for 500 hours, etc.

B-054
Billett, E.A., Bishop, J.
A Greaseless Vacuum Seal for Rotating Shafts
Journal Scientific Instrum. V. 35, p. 70, Feb. 1958

This note describes a variation on the Wilson seal, in which the grease is dispensed with by using P.T.F.E. washers on a steel shaft, taking advantage of the very low friction between these materials. The model shown uses four washers of P.T.F.E., with highly polished steel spacers separating them, both washers and spacers being 0.062" thick. Seals have been used at temperatures up to 200°C and have shown no sign of leaks greater than 10^{-5} 1/sec.

B-055
Bingham, A.E.
Hydraulic Seals for Extreme Temperatures
Shell Aviation News No. 286, pp. 14-21

Factors to consider in design of high temperature seals used in aircraft and similar applications are outlined; tabulation of fluids and elastomers and their properties; comparison between labyrinth and elastomeric glands.

B-056
Bingham, A.E.
Hydraulic Seals for Extremes of Working Temperatures, with Special Reference to Aircraft
Proceedings, I.M.E., V. 176, No. 17, pp. 409-420, 1962

Report on goals, test conducted to date, and test equipment used. Tables of fluids and their properties, elastomers and their properties, gland configuration, and labyrinth glands.
(Goals include 70° to 170°C, -26° to -40°C, 4000 lbs/in.^{2})

B-057
Birch, F., Robertson, C., Clark, S.P., Jr.
Apparatus for Pressures of 27,000 Bars and Temperatures of 1400°C
Industrial and Engineering Chemistry, V. 49, No. 12, 1965, 1966, Dec. 1957

Temperature, pressure and other variables may be costrolled and measured in the reaction zone with unusually high precision.
Neoprene washer packing and Omega steel washer backing.

B-058 T
Blair, R.W.
Controlled Gap Seal
S.A.E. Paper - 678A - 3 pp., 7 fig., Jan. 1956
S.A.E. Journal - pp. 44, Nov. 1956 (abstract)

The controlled gap seal is a form of labyrinth for sealing rotating shafts and consists of a carbon sealing ring capable of sliding radially within a housing. Experiments with such a seal are described in this report.

B-059
Blair, R.W. and others
Metal Bellows Seals
Lubrication Engng., V. 17, pp. 470-475, Oct. 1961

Study of parameters of metal bellows as used in end face seals. Gives advantages and disadvantages of two basic types of metal bellows; the hydraulically formed type and the welded type.
These seals are suited for the temperatures, high surface speeds and pressures found in the cryogenic liquid pump seal and the hot turbine gas seal in liquid fuel missiles.

B-060
Blech, K.
New Balanced Expansion Stuffing Boxes (In German)
Archiv fuer Waermewirtschaft, V. 42, p. 73, March 1938

Brief illustrated description of German patented "reaction compensator"; only two stuffing boxes are required; new type of metal packing for stuffing box also described.

B-061
Bleyle, G.A., Jr., Crosby, H.W., Kendall, R.E.
Liquid Nitrogen Pump and Vaporizer
Industrial and Engineering Chemistry, V. 49, pp. 1955-1958, Dec. 1957

To satisfy a need for dry, oil free gaseous N at pressures up to 10,000 psi, a reciprocating piston pump using unlubricated packing at -320°F was selected. Packing consisting of graphitized shredded Teflon interspaced with Teflon washers has been developed. Photographs and diagrams.

B-062
Blick
How Flanges Work and Why They Leak
Petroleum Refinery, 1953

B-063 T
Blok, H.
Discussion on Gland Seals
Int. Conf. on Lubrication and Wear., pp. 775-7, Oct. 1-3, 1957, Proc. Instn. Mech. Engnr., 1 Birdcage Walk, London, SW 1

Commenting on a paper by Jagger. An attempt is made to explain two possible mechanisms of film formation in lip seals. First, an eccentric radial pressure distribution set up by the ever present slight imperfections of machinery is the source. Based on an assumed initial radial pressure distribution and hydrodynamic theory, the author shows that there is a minimum film thickness for any corresponding film profile. Secondly, inertia effects, might create a wedging action.

B-064 B
Bloom, J.C.
The Design and Development of Rubber and Teflon High Pressure Sealing Devices for Aircraft Hydraulic and Pneumatic Systems Components
Douglas Aircraft, (Proc. 15, NCIH., V. 13, pp. 194-205, Oct. 1959)

Paper describing the development of AN 6290 O-ring for use on AND 10050 Boss and related fittings.

B-065
Bloomquist, C.R.
Gasket Seals
Final Report F-A 1858, Franklin Inst. Lab. Res. & Dev., Sept. 1956

B-066
Boeddinghaus, H.
Felt-sealed for Service
Elect. Mfg., V. 27, pp. 72, 74, 76, 94, June 1941

Wool felts serve as a good material for sealing bearings and shafts against seepage of lubricants and intrusion of vagrant matter.

B-067
Boller, L.C. and others
High Temperature Resistant Sealant Materials
USAF WADC TR 56-155, (AD110633), Dec. 1956, 59 pp.

Development of a formula for a sealant compound which is unaffected by JP-5 jet fuel for a limited period of time when fuel vapor temperature is 540°F and liquid fuel temperature is 380°F; retains flexibility and adhesion; and withstands proof testing under flexing and pressure at the liquid and vapor fuel temperatures required.

B-068
Bollinger, P.R.
Power Feed Seals
Electromechanical Design

For high pressure high temperature helium.

B-069
Boltz, R.W.
Bellows Sealing Device Protects Bearings from Abrasives
Product Eng., V. 15, p. 614, Sept. 1944

Spring actuated brass bellows which maintains continuous seal contact has been designed for planetary type miller to exclude abrasives, dust, water, and corrosion when bearings are loose, misaligned or eccentric.

B-070
Boltz, R.W.
Gaskets in Design
Mach. Design, V. 17, pp. 151-156, March 1945

Article discusses the general steps that may be followed as an aid in the selection of compression gaskets, regardless of nature of equipment in which they are to be used or the details of the closure design.

B-071
Bondroit, F.
New Developments in Packings Resistant to Chemicals (In German)
Chemic-Ingenieur-Technik, V. 22, pp. 236-8, June 14, 1950

Properties and applications, with special reference to metallic packing and combined asbestos-metal packings; valve rings; seals for shafting; illustrations.

B-072
Boon, E.F.
Seals for Rotating Shafts (In Dutch)
De Ingenieur, V. 62, pp. 43-50, July 21, 1950

The development of the mechanical seal shows clearly that a tight seal is possible. Various factors leading to a tight seal with a normal stuffing box are described. A very precise assembly of a packing is necessary to obtain a tight seal. This is possible with special tools, drawings of which are shown. Special construction to cope with excessive radial movement of the shaft are described.

B-073 T
Boon, E.F.
A Few Remarks on the Sealing of Rotating and Reciprocating Machine Parts (In Dutch)
De Ingenieur, V. 64, No. 12, pp. 33-40, 1952, (BHRA Translation No. T459, Feb. 1953; AEC Tr 5109)

Various formulas for leakage through narrow gaps are given and applied to two sealing configurations, the piston and sealing ring, and mechanical face seal. Laminar flow is assumed. An equation is presented for the leakage in a mechanical seal with a varying height gap. An effective gap, height is presented for the case where any variation is small and continuous. It is shown that contact between face and seal cannot be avoided.

B-074 T
Boon, E.F., Honingh, S.
Some Notes on Seals for Rotating Shafts
Proc. Fourth World Petroleum Congress, Section VII/A Paper 1, Rome 1955, 18 pp.

A survey of several types of dynamic shaft seals indicating general requirements and their practical deviations. Discusses the advantages and disadvantages of the packing box seal, narrow faced mechanical seals, visco seals, and dual diameter visco seals. Elementary equations are developed and experimental results are shown.

B-075 T

Boon, E.F.
Some Notes on Shaft Seals for Chemical Pumps (In Dutch)
De Ingenieur, V. 67, pp. 31-38, 1955

Tests of power consumption and leakage of soft and metal packings are described. The heat transmission through the shaft and packing is calculated. Some construction of pumps without a packing box are discussed.

B-076 B

Boon, E.F., Kriggsman, A.
Some Principles of Seals (In Dutch)
Chemisch Weekblad, V. 52, 27 pp. 526-32, July 7, 1956

This article gives some of the more elementary explanations of sealing mechanisms. The author discusses some more recent work on a flange type joint sealed with a packing, and gives useful practical details.

B-077 T

Boon, E.F., and Tal, S.
Hydromechanic Sealing of Rotating Shafts
Chem. Ing.-Tech. V. 31, 3 pp. 202-12, 1959 (In German) (Main Library Translation - T.F. 5825 - GE Co., Schenectady, N.Y.)

The pressure when generated by a screw pump is given by $p = \mu \omega d \ell / S^2 X$ when p is the pressure, μ is the fluid viscosity, ω is the shaft angular velocity, d is the shaft diameter, ℓ is the length of the threaded portion of the shaft, S is the radial gap between the shaft and the casing, and X is a coefficient which is a function of thread geometry. The author develops the exact values of X for a variety of thread shapes, and examines diffusion when the device is used as a seal.

B-078

Boreham, K.R.
Hydraulic Oil Seals
Scientific Lubrication, V. 12, pp. 47-52, 46, May 1960

Static and dynamic seals for oil-powered hydraulic equipment. Seals are mainly synthetic rubber together with some thermoplastic materials such as Fluon (PTFE). These materials can be combined with various fabrics. The description and operation of the various seal forms are presented.

B-079

Bos, J.R., Weber, E.B.
Composite Elastomer-Metal O-Ring Seals
WADC Tech. Report 59-749, 22 pp., 14 fig. - 1959

Performance evaluation of the prototype composite seals in hydraulic fluids at elevated temperatures revealed that rolling or spiralling, a failure frequently experienced with conventional O-rings, was virtually eliminated. The spring cored O-ring performed much better in static impulse tests than in dynamic reciprocating tests. Data is presented and results discussed.

B-080

Boudreau, W.F., Taylor, E.R.
Shaft Seals for the EGCR Reactor
Nuc. Sci. Abst. #28385, (V. 16, No. 20, Oct. 31, p. 3713), (TID7631 (Pis-25))

A design description of the E.G.C.R. shaft seals is presented. Specifications for H_e leakage from the EGCR cooling system limit the loss to 1 percent per day. The discussion is devoted to a description of the floating-bushing seal, buffering and H_e removal system, gas transfer paths, back-diffusion, predicted operating parameters, and seal configuration.

B-081 T

Boudreau, W.F., Taylor, E.R.
Appraisal of the Applicability of Liquid-buffered Floating Bushing Shaft Seals to the Circulators for a Gas Cooled Reactor
Int. Conf. on Fluid Sealing Paper C6, April 17, 19, 1961, (12 pp.), British Hydromechanics Research Association, Harlow, Essex, England

The requirements which must be met by the shaft seal for a gas cooled reactor are presented, and the basic configuration of the seal is discussed. The relationship between the seal and circulator design is reviewed briefly, and an appraisal is presented on the selection of the buffer fluid and on the requirements for the gas purification system. Some anticipated design, requirements for shaft seals for future reactors are discussed.

B-082

Boulloud, J.P., and Schweitzer, J., (In English & French)
Experimental Study of Metal Gasketed Joints for Ultra-high Vacuum
Vide, V. 14, No. 82, pp. 241-249, July-Aug. 1959

B-083 B

Boussand, T.
The Problem of Seals
Tech. Sci. Aeronaut., No. 1, pp. 35-9, 1947 (In French)

The article describes various types of joints such as metallic, plastic and resilient joints. It compares the value of different materials such as natural rubber Buna S, and GRS., Neoprene, Perbunan, "Thioplastes," mixtures of butyl rubber, polyvinyl alcohol, and plastic materials. A table is given showing the swelling of the various types of rubber.

B-084 T

Bowden, A.T., Martin, G.H.
Design of Important Plant Items
Int. British Nuclear Energy Conference V. 2, pp. 156-67, April 1957

A discussion of the gas seal in the centrifugal gas circulators in the Calder Hall Atomic Reactor. The seal is comprised of a labyrinth, a floating bushing, and a "stand still" seal which is an elastomeric ring forced into contact with the rear of the centrifugal impeller when the compressor is stopped.

B-085

Bower, E.S., and Vandermar, B.C.
Chemical and Mechanical Development of Elastomeric Piston Seals for Automatic Transmissions
SAE Paper No. 1A, 8 pp., Jan 13-17, 1958

Characteristics of butadiene-acrylonitrile copolymers; requirements target specification for screening compounds, rubber compounding of right butadiene-acrylonitrile ratio; fabrication and testing of seals; compounds based on fluorocarbon rubber.

B-086
Bower, E.S., Vandermar, B.C.
Chemical and Mechanical Development of Elastomeric Piston Seals for Automatic Transmissions
Rubber World, V. 138, p. 115, April 1958, SAE Journal, V. 66, p. 130, April 1958

B-087
Bower, E.S., Vandermar, B.C.
Seal Changes Solve Special Problems
SAE Journal, V. 70, 48-9, June 1962

Modifications to the standard lip seal design solved these problems for one manufacturer.
(1) The seal section was deepened to keep it in place.
(2) The back of the seal was chamfered to get it away from the area of extrusion.
(3) The stretch fit was tightened up to keep the seal from lifting off the bottom of the groove.
(4) The compound used for seal material was adjusted for extrusion resistance. Drawings included.

B-088
Bower, E.S., Vandermar, B.C. (Acadia Div., Western Felt Works)
Reciprocating and Static Seal Designs of Elastomeric Compounds
S.A.E. Paper 475G, September 1962

B-089
Bowman, H.A. and Cross, J.L., et al.
Impregnated Teflon as a Packing Material at 150,000 PSI
Rev. Sci. Instr. V. 27, p. 550, 1956

Teflon impregnated with 5 wt. percent MoS_2 proved to be satisfactory packing material in the high-pressure moving seal of differential area pressure intensifiers.

B-090
Box, J.R., Weber, E.B.
Spring Cored O-Ring Investigation - Quarterly Progress Report No. 1
Report No. E9R - 12212, Chance Vought Aircraft, Dallas, Tex., 24 pp., April 8, 1959

Reports evaluation of a spring cored O-ring with Viton A elastomer compound. Pressure impulse test in the CVL-2249 cylinder assembly. System pressure 400 psi and tests would be conducted at 400°F. Impulse pressure cycles -40 per min. Table of Survey of Elastomeric materials for use with spring cored O-rings.

B-091 T
Boyd, J., Robertson, B.P.
Oil and Temperature Relations in Lightly Loaded Journal Bearings
Trans. Am. Soc. Mech. Engrs., V. 70, pp. 257-262, April 1948, Lubrication Engineering, V. 4, pp. 58-62, April 1948

The oil flow and operating temperature were studied in a series of tests of high spedd, lightly loaded full journal bearings. The oil flow through a lightly loaded bearing having a circumferential supply groove would be quite similar to the oil flow in a buffered bushing seal. Good agreement between theory and experiment was reported.

B-092
Boyd, W.W.
Spiral Wound Gaskets on Flanged Joints
Pet. Refiner, V. 30, 120-3, Dec. 1951

B-093
Bradford, B.W., and Skinner, W.J.
Improvements in and Relating to Seals
British Patent 809,281 Feb. 18, 1959

The preparation of graphite seals for rubbing use in UF_6 vapor is described.

B-094
Bradford, B.W., and Skinner, W.J.
Molded Sealing Element
US Patent 2,879,247 March 24, 1959

Molded sealing elements suitable for use under conditions involving exposure to uranium hexafluoride vapor are described.

B-095 T
Bradford, L.J.
Oil Film Pressures in End Lubricated Sleeve Bearing
Technical Bulletin No. 14, School of Engineering, the Pennsylvania State College, 1931 (pp. 90-104)

This report deals with an early experimental study of the film instabilities in low clearance end-lubricated journal bearings. Cavitation as such is not mentioned in the report, but the conditions observed and reported on seem to suggest this type of instability which was more pronounced when the lubricant supply was to only one end of the bearing.

B-096
Bragdon, C.T., and Monich, M.T.
Integral Seal Ball Bearings
Prod. Engng., V. 26, pp. 179-185, Nov. 1955

Analysis of types of seals; relation of combination of bearing and performance; seal materials; effect of temperature and speed; design suggestions.

B-097 B
Brenza, J.J., Fuchsluger, J.H.
Evaluations of Designs and Materials for High-speed, High Temperature Shaft Seals for Turbojet Engine Application
Part II-WADC Tech. Report 56-267, 23 pp., 14 fig., 11 tab, Dec. 1958

Various designs of both circumferential and radial face seals were subjected to test during the program of work described in this report, and their relative merits are discussed. 163 different materials were evaluated, 1000 hours life, 10,000°F, 200 lbs/sq. in. 30,000 ft/min rubbing speed.

B-098
Bresee, J.C., Watson, C.D., Watson, J.S.
Gamma Radiation Damage Studies of Organic Protective Coatings and Gaskets
Oak Ridge Natl. Lab. (U.S.A.E.C.), ORNL-2174, 30 pp., Nov. 1956

Qualitative results of screening studies, quantative results of decontamination test and physical property measurements.

B-099
Bridgman, P.W.
Methods of Handling Very High Pressures
Comp. Air Mag., V. 27, pp. 17-19, Jan. 1922

Explains methods of packing pistons and joints to withstand pressures up to 500,000 psi.

B-100 T
Brillie, H.
Viscous Fluids at High Velocity and Their Effects on Bearing Surfaces, Propeller Blades etc. (In French)
Le Genie Curl, V. 114, pp. 10-13, 33-35, 1939

The author notes the erosive damage which has been reported on the surface of bearings, propeller blades, and hydraulic turbines, and suggests that the only rational explanation of this effect is cavitation.

B-101
Brkich, A.
Mechanical Seals, Theory and Criteria for Their Design
Product Engng., V. 21, pp. 85-89, April 1950

Effects of surface tension, liquid back pressure, viscosity, spring force and face proportions on leakage through mechanical joints.
Qualitative basic equations are derived for leakage through gaps and then analyzed to explain the performance of seals with volatile and non-volatile liquids.

B-102 T
Brkich, A.
Sealing Device for Relay Pump Shafts
US Patent 2,710,205 June 7, 1955

The use of a flow restricting bushing between two annular chambers sealed at the outer ends by identical mechanical face seals. Buffer fluid at a pressure greater than that of the substance to be sealed is used. By suitably restricting respective flow rates, the pressure drop across the two mechanical seals are each substantially less than the total pump pressure.

B-103 B
Brkich, A., Allen, R.E.
Development of Floating Ring Type Stuffing Boxes for Eddystone Boiler Feed Pumps
A.S.M.E. Paper 59-A-259, 5 pp., 9 figs., Nov-Dec. 1959

Recent increases in the size, pressures and operating temperatures of boiler feed pumps have required new designs of stuffing boxes, to be undertaken and the authors report on their successful work in this field. 1750 rpm shaft, 4.5 in dia., sealing 650 lb/sq.in. 435°F.

B-104
Britt, J.R.
Elastomer Compounds for High Vacuum Application
U.S. Naval Research Laboratory, 12 photos., diagr., July 1951, PB 104729, Off. Tech. Ser.

A compounding study using butyl, neoprene, and butadine-acrylonitrile type elastomers as high vacuum seal is presented. Vacuum ranges 10^{-5} to 10^{-6} MM for the rapid pumping systems used. Test data and results.

B-105
Broadbent, E.R.
Performance of Linear LTZ-70 Hydraulic O-Ring Packing used with Chrome Retanned Leather Back-up Rings at 3000 PSI Pressure.
Douglas Aircraft Co. Report, SM-11809, April 4, 1946

B-106
Broadway, N.J., and Palenchak, S.
The Effect of Nuclear Radiation on Seals, Gaskets, and Sealants
Battelle Memorial Inst., Radiation effects Information Center, Columbus, Ohio., NR-7096, Project No. 2133, November 30, 1958, Contract AF33 (616)-5171

Various sealing materials were irradiated at temperatures up to 450°F and evaluated. A few of the materials tested - nitrile, neoprene, Teflon, Viton A and thiokol rubbers.

B-107
Broce, J.R.
How to Inspect and Maintain Mechanical Seals in H.T.W. Pumps
Power, V. 105, 190-3, Dec. 1961

Mechanical seals is equipment of a high order built to very close tolerances, and for proper operation it requires careful installation. In hot water applications, temperature control is a must. Detailed description of installation, operation, and maintenance. Sixteen steps with pictures for each.

B-108
Brodsky, J.
Consider the Boiler Gasket
Power Plant Engineering, V. 40, No. 12, pp. 712-13, Dec. 1936

General commentary on surface preparation, gasket selection and application as maintenance procedure.

B-109
Brothman, A.
Stuffing Boxes; Pressure Sealing Devices for Rotary Shafts
Product Engng., V. 11, pp. 417-419, Sept. 1940, pp. 520-522, Nov. 1940

Types of stuffing boxes are illustrated. A table lists materials utilized for packings and seals v.g., asbestos hemp, rubber, babbitt, white metal, carbon rings etc. Norms for selection and maintenance of stuffing boxes are discussed.

B-110
Brown, E.D., Jr.
Investigation of Carbon and Carbon Substitute Seal Materials
R58 Ch SD-117, GEL Tech. Data Center, G.E. Co., Sch'dy., N.Y., 4 pp., Dec. 29, 1958

Lists criteria of seal materials as materials which must be able to operate dry or nearly dry; partly lubricated; or lubricated, all without damage to seal material or contacting shaft. For conventional lubricants in use, notably petroleum fluids and diesters, most satisfactory material is carbon. Carbon additives which are discussed, make it possible for operation at 1300°F and hotter.

B-111
Brown, Wm., Razdow, A.
Reusable Seals for Electronic Equipment
P.B. 131194 - Off. Tech. Ser. (94 pp., photo, dwg. diag. 8 r) May 1957

This report covers the investigation, evaluation, and establishment of the most effective type of reusable seals for airborne electronic equipment. Fused seals, methods and procedures were developed for hermetically sealed enclosures of electronic assemblies, subassemblies, and equipment, so they can be opened fifteen times for repair and resealed without destroying the contents therein. The methods developed are satisfactory for field service application.
AD 130772 Project 4526, Task 41602 - Summarizes research from June 1, 1955, Oct. 31, 1956 under contract AF33 (616) 294 AF WADC TR 56-616.

B-112 T

Browne, L.H.
Rotary Seal
US Patent 2,230,881, Feb. 4, 1941

A seal through which fluids may be fed to a rotary shaft for distribution to a pressure actuated device. Two opposing face shields are provided with a lubricant to prevent leakage of the pressurized fluid to the atmosphere. A visco seal or labyrinth seal retards the leakage of this lubricant into the pressure passage.

B-113 T

Browne, L.H.
Rotary Seal
US Patent 2,270,927, Jan. 27, 1942

The device allows a fluid to be passed through a stationary collar with an inner annulus through radial holes to the center of a rotating shaft. The seal is a double mechanical face seal. The annular space between the seals forms a collecting volume for the fluid in transit.

B-114 T

Browne, L.H.
Shaft Seal
US Patent 2,270,928, Jan. 27, 1942

A method sealing a joint between two tubes or hollow shafts which must have relative motion while transporting a fluid medium. In one design, fluid pressure forces a sealing ring jointly against the inner and outer race of a ball bearing. Another design used fluid pressure to force a sealing ring against the perpendicular end of one member with which the ring is in relative motion.

B-115

Browning, W.E., and Zizzo, S.G.
Life Expectancy of Organic Gasket Material at the Transition-precessor Position Within the Mark I Accelerator Shielding
Calif. Res. & Devel. Co., Livermore, Calif., LWS-22505, CRD-A17-41, 6 pp., Jan. 15, 1953

The life expectancy of elastomers vs gaskets between the transition-precessor position are predicted suitable for 10^3 hours to 10^4 hours under the anticipated neutron flux conditions of 2.7×10^7 neutrons/cm^2 sec.

B-116

Brueschke, E.E.
A Leak-free Method of Transmitting Motion into Ultra High Vacuum
Vacuum, V. 11, No. 5/6, pp. 255-259

A description is given of a seal which is leak-free and can be used to transmit rotary and limited translational motion into ultra high vacuum. The seal is accomplished by using a low vapor pressure liquid in combination with a rubber gasket. The seal is useful at 10^{-9} Torr and below and therefore has excellent application for testing of mechanisms, bearings and materials in ultra high vacuum.

B-117

Brueschke, E.E.
Ultra-high Vacuum Seal for Space Simulation Systems
Rev. Sci. Inst., V. 32, pp. 732-4, June 1961

The operation and construction of a leak-free seal, by means of which limited translational and unlimited rotational motion in a vacuum can be obtained, is described. The seal is accomplished by using a rubber gasket in combination with a liquid which is in equilibrium with internal and external pressure. This seal can be operated from zero to several thousand rpm and can be used at 10^{-9} mm Hg and lower without difficulty. The seal has distinct advantages for use in space environment simulation chamber and other ultra-high vacuum apparatus.

B-118

Bruno, J.O.
Investigation of Hydraulic Low Friction Teflon Cap Seals
PB 133979, Off. Tech. Sev., 61 pp., photo, dwg., diags., graphs

A low friction rod seal was required for hydraulic actuators which would increase O-ring life and minimize rod seal leakage. A test actuator, rod seals, and corresponding hydraulic impulses and driving circuits were designed and built. Both static and cycling tests were conducted on various size seals with varying cross sectional O-ring squeeze.
Final Design criteria are shown.
AD 118213, Project 1371, Task 13495. Contract AF33 (601) 28637, AF WADC TR 57-163.

B-119

Bryan, J.D.
Valve Seals Prevent Oil Loss
Diesel Power, pp. 86-87, Sept. 1959

Positive sealing of valve stem-to-guide clearances saves oil, cuts maintenance costs, improves engine performance.

B-120 T

Bryant, J.M.
Sealing Drives and Anti Friction Bearings
Design News, V. 12, No. 71, pp. 156-57, April 1, 1957

The author describes the types of seals available (clearance or labyrinth, lip or axial seals, and face seals) and lists applications of each type.

B-121 T

Bryant, J.M.
Types and Characteristics of Bearing Seals
Machine Design, V. 29, pp. 127-132, April 4, 1957

This abstract of an American Society of Lubrication Engineers Paper compares the sealing characteristics of clearance seals and closure seals as required for sealing rolling-element bearing.

B-122

Bryant, J.M.
Match Drive and Bearing Seals to Service Conditions
Iron Age, V. 179, pp. 136-138, No. 24, June 13, 1957

Standard and special seals for mechanical drives and anti-friction bearings; recommendations for choice of effective seal.

B-123 T

Bryant, R.W., Dukes, W.A.
Some Sealing Materials for Threaded Joints
International Conference on Fluid Sealing, Paper B3, April 1961, British Hydromechanics Research Association, Harlow, Essex, England

The development of special sealing compositions, both lutings and cement for paralleltthreaded joints is summarized and their performance is described.
The most important single factor in the sealing of threaded joints is the quality of the composition.
Desirable qualities are discussed.
Cements which dry merely by evaporation of solvent are greatly inferior to solvent-free cements and lutings.

B-124

Brymner, R., and Steckelmacher, W.
Demountable Vacuum Seal for Operation at Temperatures from - 188 to 800 C
Jour. Scientific Instruments, V. 36, pp. 278-281, June 1959

Static metal seals made from flat gasket sheets of soft copper, iron, stainless steel, aluminum or nickel. These are compressed to a cone shape by metal flanges of mild steel or stainless steel. The seal depends on a surface-friction effect instead of compression. The same seal may be used many times on the same pair of flanges.

B-125

Buckley, D.H., and Johnson, R.L.
Halogen Containing Gases as Lubricants for Crystallized-Glass-Ceramic-Metal Combinations at Temperatures to 1500°F
NASA TND-295, 19 pp., Oct. 1960

Pyroceram 9608 (a crystallized glass ceramic) has been considered for use in high temperature bearing and seal applications. One of the problems encountered with Pyroceram is the lack of availability of lubricants for the temperature range in which this material becomes practical. Experiments were conducted with Pyroceram sliding on various nickel- and cobalt-base alloys using reactive halogen-containing gases as lubricants. Friction and wear data were obtained as a function of sliding velocity and temperature.

B-126

Buckshee, W.
New Hydro Gland Packing Really Works
Power Engng., V. 63, p. 70, April 1959

New seal for hydroelectric turbines provides effective solution to problem of shaft cutting by tight packing, or leakage when packing is not sufficiently tight; silicone "Klozure" impervious to water temperature in Northern Canada has given two years successful trouble free operation; Al or bronze adapting rings are used in gland.

B-127

Bunn, J.
Best Methods for Preparing Journal Box Packings
Railway Master Mech., April 1901

Illustrated description of vats for treating packings.

B-128 T

Burger, F.E.
Mechanical Seals for Rotating Shafts
Aircraft Engineering, V. 19, pp. 93-4, March 1947

The author's design of a special shaft sealing ring is described. The seal consists of two or more carbon rings of varying cross-sectional area, having a gap cut at the minimum area section. As each ring is pressed on the shaft, its inside dimensions remain circular. A mathematical treatment is presented to arrive at numbers for frictional torque and horsepower loss. No data presented.

B-129

Burger, F.E.
Mechanical Seals for Rotating Shafts
Engrs. Digest, V. 4, pp. 313-314, July 1947

Early concepts of the labyrinth seal and soft packing seals is reviewed, together with their limitations. Surface finish of shaft and selection of seal materials with low coefficient of friction recognized as critical. Synthetic carbon containing metal oxides and other admixtures selected as affording one of most suitable substances.
A developed seal utilizing this material is described together with mathematical treatment.

B-130

Burns, David L.
Leakage of Water from Pump Mechanical Seals
Nuclear Science Abstract 20564, (DP-666) (Du Pont de Nemours & Co., Savannah River Lab., Contract AT (07-2)-1), 11 pp., Nov. 1961

Measurements of water vapor leakage past mechanical seals for pump shafts showed that commercially available mechanical seals do not leak more than about 30 lb/yr of vapor. Both vapor and liquid leakage were measured in bench-scale tests on mechanical seals from three manufacturers for pump shaft sizes of 2.625- and 3.563 with diameter, shaft speeds from 500 to 3600 rpm, and pressures from 250 to 1000 psig. Leakage of D_2O would be recovered.

B-131

Burns, R.C.
Cleaning and Lubricating of Brake Cylinder Packing Leathers
Railway Review, July 28, 1917

B-132

Burrows, G.
Improvements Relating to Sealing Glands
P.P. Starling, E. Metropolitan-Vickers Electrical Co. Ltd., Br.Pat. 703696

A rotary seal is described which allows relative movement between a stationary and a rotating part of a high vacuum system. The two parts end in flanges between which are two concentric sealing rings of some flexible material; these are fixed to one flange and slide on the other. The interspace between the two rings is connected through the fixed flange to a source of rough vacuum so that the pressure difference across the inner ring is small and the leakage negligible.
A ball-race may be fitted between the flanges to space them apart and the clearance is adjusted by screws to give optimum sealing.

B-133
Butler, C.A., and Sutter, R.S.
Pump Stuffing Box for Obnoxious or Inflammable Liquids
Oil & Gas J., V. 49, p. 117, Aug. 17, 1950

In problem involved, operator could not stay in pump house with even slight drip from packing; liquid was solvent which made grease sealing impossible; gland could not be sealed with water; in solution of problem, principle of liquid-sealed centrifugal shaft packing was combined with action of backvanes on pump impeller; dry air was used to keep pumped liquid from coming in contact with stuffing box; diagram of actual installation.

B-134 B
Butler, C.A., Sutter, R.S.
A Leak-proof Stuffing Box
Chem. Engg., V. 57, 9, p. 117, September 1950

Description, drawing, and application of a leak-proof stuffing box.
Air pressure keeps liquid away from shaft, and liquid annulus keeps air out of pump.

C-001
Cable, J. A.
Selection and Maintenance of Centrifugal Pump Seals
Power Eng., V. 57, p.82-3, Nov. 1953
Some tips on selecting the proper pump seal for the job and giving them proper maintenance when installed.
Subjects discussed: - packed stuffing boxes; difficult liquids vs. boxes; repacking hints; mechanical seals; difficult liquids vs. seals; replacing mechanical seals.
Photographs and drawings.

C-002 T
Cable, J.A., Kristy, O.M.
How to Maintain Stuffing Boxes That Have Mechanical Seals
Power Engineering, V. 62, p. 88, 1958
Practical tips on mechanical seal maintenance.

C-003
Cady, E.L.
Packology
Mill & Factory, V. 36, pp. 134-136, 325 etc. March, 1945.
Evaluates and describes the application of the more common packing materials for pumps, valves, expansion joints, etc.

C-004 B
Cameron, D.H.
Nylon Pipe Joints for Use in Hydraulic Services Up to 3,000 lb/sq. in.
Proc. 14th B.I.S.R.A. Plant Engg. Conf. (Hydraulics in the Steel Industry)
pp. 87-91 disc. pp. 91-3. March 1957

C-005
Campbell, J.A.
Fundamental Characteristics of High Performance Hydraulic Systems
PB 114178, Off. Tech. Serv., (258p; photo, dwgs, diag. gr. June 1950)
Results from literature surveys, theoretical studies, and experimental work include: variations in fluid viscosity and density with temperature and pressure; frictional characteristics of O-Rings at various squeezes, pressures and temperatures; hydraulic damping or resistance factors for tubing, fillings, and buses, etc.

C-006
Candee, R.
Oil Seal Applications in Farm Tractors
SAE Paper n 23, 7 p., Jan. 14-18, 1957
John Deere Waterloo Tractor Works, procedure in approaching operating conditions and securing recommendations of manufacturers of seals; applications on right-hand crankshaft bearing; experience with three basic types on front wheels, namely; packing, lip, and face-type seals.

C-007
Cannizzaro, S.
Republic Tests Seals for 1000°F Hydraulics
Space Aeronautic, V. 35, pp. 103-104, 106, 108, 110, April, 1961
Composite metallic seals for use in hydraulic systems having an ambient temperature of 1200°F and a liquid temperature of 1000°F are developed using Ag impregnated Mo, 430 stainless steel filled with 84Ag - 16 In brazing alloy, Nu Die V and Rex AAA tool steels and Haynes Stellite.

C-008
Cannizzaro, S., Lee, Jr. Schroder, R.
Sealing in Severe Environments
National Conference on Industrial Hydraulics, V. XV, pp. 187-199, October, 1961
This paper discusses design techniques, and results of three programs concerned with sealing in severe environments, recently completed, or currently conducted. 275°F pneumatic system, 600°F hydraulic system. Elastomeric dynamic seals; non-elastomeric dynamic seals; static seal testing, metallic boss seals. Tables of test data and results discussion.

C-009
Cannon, C. H.
1000°F Pneumatic Servo System
SAE Journal, V. 66, pp. 70-71, April, 1958
Design requirements of a new Lockheed aircraft pneumatic system operation at 1000°F and 5000 psi for 500 hours life. Leakage and lack of high temperature materials with required mechanical characteristics are major problems encountered. The system will be used to operate the dive brakes of a supersonic aircraft. (Indicates steps being taken - no data results)

C-010
Cannon, R.
How to Choose and Use Today's Gaskets in Today's Equipment
Petroleum Processing, V. 12, pp. 95-110, March 1957
Gasket construction, functions, material, and designs.

C-011
Carlotta, E.L.
Synthetic Rubber O-Ring Seals
Prod. Engrg., V. 22, pp.130-135, June 1951
For sealing of static or moving parts in hydraulic systems, "O"-rings have become widely accepted. Large number of synthetic rubbers available increases this acceptance.
Synthetics include butyl, GR-S rubber, polysulphide rubber, silicone rubber, nitrile rubber to mention a few. These rubbers are compatible with hydraulic fluid, aromatic fuels, dilute acids and alkali, Freon gas, etc. Design and installation problems are discussed.

C-012
Carlotta, E. L.
Materials for O-Ring Seals
Materials and Methods, V. 38, pp. 104-107, Dec., 1953
Material requirements for O-rings are exacting. Natural and synthetic rubbers, silicon elastomers, and plastic elastomers meet many of these prerequisites which are discussed in detail.

C-013
Carlotta, E.L., and Hobein, E.M.
Limitations of Synthetic Rubber Packings For High Temperature Applications
Rubber Age, V. 74, pp. 85-90, 134, Oct. 1953
Heat resisting potential of available elastomers for use as molded seals in various components of hydraulic and pneumatic systems on military and civilian aircraft; discussion covers compounding, design of rubber-containing units for operation at elevated temperatures, and comparative properties.

C-014
Carlson, A.F.
Interim Report of Conical Seals for Flared Tubing
Bulletin No. B707J, Chrysler Corp., Detroit, Michigan

C-015
Carlson, A.F.
Test of Conical Seals for Flared Tubing
Bulletin No. B-767J. Chrysler Corporation, Detroit, Michigan, March 10, 1961

C-016
Carlson, N.J., Black, W.S.
Joints for High-Pressure High-Temperature Piping
Trans. ASME, V. 73, pp. 237-46, 1953

Outlines briefly the difficult problem of obtaining leakproof joints for high-pressure, high-temperature piping. It includes the results obtained from an extensive test on three full-sized joints for connecting ferritic alloy main steam piping to austenitic-alloy turbine equipment of 150,000 kw capacity. Description of joints. Performance tests-procedures. Pressure seal joint.

C-017
Carlson, R.W.
Friction Characteristics for Hydraulic Seals
Product Engrg., V. 27, p. 221, May, 1956

Four-lipped seal developed to replace standard O-ring and gaskets under listed conditions. Comparison data shown.

C-018
Carter, R., Karassik, I.J.
Designing, Constructing and Maintaining Centrifugal Pumps; Mechanical Seals
Water and Sewerage Works, V. 103, pp. 27-30, Jan., 1956

The basic principles of mechanical seals are presented, and a few of the various types of construction are described, along with their limitations.

C-019
Cass, E. and McCuistion, T.J. and others
Applied Hydraulics & Pneumatics, V. 13, pp. 132-133, Oct., 1959

Description of test procedure, and result of investigation to determine amount of force required to compress O-rings; log-log plot of compression force vs deflection enables rapid calculation.

C-020
Chandler, W.L.
Bellows in the Refrigeration Industry
Refrig. Engrg., V. 42, pp. 297-299, Nov., 1941
pp. 381-382, etc., Dec., 1941

The principal bellows applications are bellows-type seals for rotary shafts, motor elements for expansion valves, thermostat elements for expansion valves and switches and bellows-type packless valves for shut-off and other service. These are described in part 1.
Part 2 describes the following properties of bellows:
1. Spring rate or flexibility 2. Pressure resistance
3. Mean effective area 4. Fatigue.

C-021
Chapman, C.S.
Sealing Problems in Current Passenger Car Automatic Transmission
S.A.E. Paper 475D - September, 1962

C-022
Charlton, G.J.
Proper Method of Packing and Lubricating Journals
Railway Master Mechanic, June, 1914

Outlines the quality of waste and oil and describes the proper method of packing.

C-023
Cheney, L.E.
O-Ring Friction Characteristics
Mach-Design - V. 21, pp. 245-6, April, 1949

The recently developed O-ring shows many advantages over V-ring and U-cup packings. The effect of pressure, 500, 1000, 1500 psi were checked. It was found that an increase in pressure resulted in a small increase in running friction. Rod finish was checked 2.8-3.2, 6-8, 10-12, 16-18 micro inches rms. and results evaluated.

C-024
Cheney, L.E. and McCuistion, T.J.
Aircraft Hydraulic Packings; Factors Influencing Their Performance
Mech. Engrg., V. 70, pp. 675-679, Aug., 1948

The several factors influencing the performance of hydraulic packings for aircraft are discussed, both of a design and application nature.
Packings are V-ring, T-ring, O-ring, and U-cups, with special emphasis on O-ring packings made from natural rubber GR-S, GR-I (butyl) and Buna N, a nitrile type of rubber. Experience with thermoplastic materials negative.

C-025
Cheney, L.E. and Mueller, W.J., and Duval, R.E.
Frictional Characteristics of O-Rings with Typical Hydraulic Fluid
Am. Soc. Mech. Engrs.-Trans. V. 72, pp 291-7, April, 1950

O-ring packings employed in aircraft hydraulic systems are subject to numberous operating variables, which affect the friction involved in their operation. A method for studying the friction is described, and the effects of several variables— pressure, time delay, squeeze, stroke speed, ring size, and surface finish of the moving metal part— have been determined. Charts showing friction versus pressure, squeeze, time delay, surface finish, stroke speed and reproducibility.

C-026
Chinnery, R.
Bellofram Rolling Diaphragms
Hydraulic Power Transmission V. 8, pp. 325-7, May, 1962

Diaphragm design for frictionless packing for sealing pressurized fluid; applications

C-027
Chirkin, V.S.
Acid-resistant Packing Made of Polyvinyl Chloride
Khimicheskaya Prom., V. 2, p. 20, 1945

Packing for glands in systems carrying acids is made from plaited strips of polyvinyl chloride. To prevent raveling, the ends of the braid are fused together by heat.

C-028

Chittenden, W.A., Hoveke, G.F.
Heavy Water Reactor Plant Leakage
Atomic Energy Commission Report SL 1874, June 30, 1961

Test program results to appraise D_2O leakage rates from turbine shaft seals, pump shaft seals, and valve stems. Mechanical seals, packing seals, throttle bushings, and floating ring seals.

C-029

Christian, G.L.
Seals Designed for Supersonic Speeds
Aviation Week, V. 64, pp. 97-98, June 11, 1956

External sealing and molding for canopy cracks, flap edges, and other uses are now being designed and manufactured with the same extreme care that goes into any part of a supersonic airframe. Demanding seals which hold their shapes are highly scuff-proof, and resist rubber ruining ozone and temperature extremes ranging from - 100°F to 500°F. Silicone rubber family developed. Data is given, applications are discussed. Photographs.

C-030

Chupp, W.W.
Flanged Joint Sealing Gaskets
US Patent No. 2,532,891, Dec. 5, 1950, U.S. Atomic Energy Commission

The gasket seal described in this patent comprises a pair of rings of compliant material arranged concentrically and in spaced relation to form an annular cavity. In association with the rings are one or more mechanical stops adapted to limit the deflection which the rings may undergo during compression and induce proper alignment of the surfaces which contact the rings.

C-031 B

Cianetti, E.
A Study of Behavior of Some Elastomeric and Plastormeric Materials for Packings
Min. Difesa Publ., pp. 23-35, 1956
In Italian MOS Translation TIL/T 4937, Oct., 1958

This report contains the results of a comprehensive study of various properties of several elastomers and plastomers. Particular attention has been given to their behavior when exposed to liquid hydro-carbons and low temperatures and to the change in their characteristics due to aging.

C-032

Clark, A.F.
Careful Design Prolongs Packing Life
Machine Design, V. 5, pp. 29-30, 39, June 1933

Selection of material for particular application; materials available are leather, felt, cork, cotton, asbestos, and rubber.

C-033

Clark, A.F.
Sealed and Shielded Bearings Aid in Design Simplification
Machine Design, V. 6, No. 8, pp. 22-24, Aug., 1934

Bearings with shields and seals combine several necessary details into a single unit, resulting in longer life, and ease of application. Advantages, limitations and applications.

C-034

Clark, E.H.
Mechanical Packing Design; Cup and Flange Types
Prod. Engrg., V. 16, pp. 474-475, July, 1945

Design features and certain basic rules for designing cup and flange packings are presented.
Cup packing used mainly on pistons, plungers or rams on hydraulic or pneumatic service.
Flange packings used in packing recesses both for reciprocating plungers and as seals on rotating shafts. Types are well illustrated.

C-035 B

Clark, F.E., Ball, W.P., and others
Molding of O-Ring Packings
Rubber Age, (NY) V. 62, 61, pp. 652-4, March, 1948
Also, P.B. 94015 Off-Tech. Serv., March, 1948

C-036

Clark, J.F.
Sealing Studies on Cartridge Actuated Devices
PB-138726, Off. Tech. Ser., 33 pgs., (Rept. No. R-1469), Sept. 1958

Investigations were conducted using quad rings as sealing media. Each of these products was found to be effective in specific applications; however, the O-ring was particularly adaptable to existing cartridge actuated devices and was used almost exclusively in the modification made under this program.

C-037

Clark, P.M.
Freeze Seals
Knolls Atomic Power Lab., Gen. Elec. Co., Schenectady, N.Y., Contract W-31-109 Eng-52, 6 p., July 14, 1952

Results are presented from tests on an air-cooled freeze seal suitable for use in submarine thermal reactor service lines. The seal is considered a one-way freeze seal because it will pass gas in one direction only without emptying the liquid from the seal.

The test arrangement is illustrated and performance data are summarized.

C-038 T

Clark, P.M.
Mechanical Pumps for High Temperature Liquid Metals
Mechanical Engineering, V. 75, pp. 615-8, August, 1953

Most of this article is devoted to the seals developed for obtaining zero leakage of sodium-potassium mixtures at temperatures greater than 750°F. A long overhung, oversized shaft was used with an inert gas sealed labyrinth seal which was surrounded by a cooling oil jacket. To seal the gas, which might absorb NaK vapors, a rotary face seal was employed above the labyrinth seal. The seal was lubricated with approximately 30 drops of oil per day which was collected in a trap and drained periodically. Seal life was generally more than 2000 hours. Test to determine best seal was run.

C-039
Clark, R.A. and Cheyney, L.E.
Compounding of O-Ring Hydraulic Packings
Rubber Age (NY), V. 65, pp. 531-6, 1949

The requirements of O-ring hydraulic packings for service in aircraft, automobiles, locomotives, hydraulic presses and many other types of equipment and machinery are reviewed with special reference to Army-Navy.
Aeronautical Specification AN-P-79.

C-040 B
Clark, R.A., Kell, R.M.
Swelling and Drying of Fuel O-Rings
Rubber Age (NY), V. 75, 6, pp. 831-7, September, 1954

The purpose of this investigation was to shorten a full O-ring test procedure by using temperatures up to 250°F to accelerate the rate of O-ring swelling and drying. Free and confined samples from five commercial sources were tested.
30% aromatic fuel - 65° to 250°F.

C-041
Clark, R.A.
TFE Plastic O-Rings
Machine Design, V. 34, pp. 221-222, Apr. 26, 1962

Tetrafluoroethylene plastic O-rings are used for static and dynamic seals, but are frequently unsatisfactory for dynamic seals because of poor wear characteristics. Their surfaces are easily damaged, so they must be installed carefully and against smooth surfaces to avoid leaks.
They have good chemical and heat resistance, low coefficient of friction, flexural strength and toughness. They can be heated, stretched and shrunk fit on diameters as much as 30% greater than the O-ring groove.
Groove design for the rings, and their deformation under load are discussed. To avoid creep failures a means of maintaining pressure such as heavy initial loading, spring-loading, use of adjustable glands, or use of filled TFE O-rings should be employed.

C-042
Cline, R.W.
Packing Gland Redesign Reduces Pump Maintenance
Applied Hydraulics, V. 8, pp. 100, 102, 104, October, 1955

System developed for Goshen Rubber Co., Goshen, Ind.; adapter made of bearing bronze fills space originally occupied by packing; one groove contains O-ring operating as dynamic piston rod seal, other containing second O-ring operating as static seal; application to presses in rubber molding shop, powered by weighted accumulator system charged with water at 2000 psi from Triplex pump.

C-043 T
Clinebell, B. J.
O-Rings - An Annotated Bibliography
India Rubber World, V. 27, pp. 74-78, 1952-53

Eighty-nine references are listed.

C-044 B
Clond, R.W., Philip, S.F.
Vacuum Test of Rubber, Lead, and Teflon Gaskets and Vinyl Acetate Joints
Rev.Sci. Instrum., V. 21, pp. 731-3, Aug. 1950

Rubber, Teflon, and Vinyl Acetate sealed systems are compared, by an approximately quantitative method, with a lead gasket sealed system.
Time pressure curves, data, tables presented.

C-045
Close, G.C.
Improved Rubber O-Ring for Hydraulic Service
Matls. & Methods, V. 42, pp. 100-1, Oct. 1955.

New molding technique, called Danby process, developed at Plastics and Rubber Products Co., has practically eliminated internal laminations and stresses within structure of O-ring; advantages of new molding method are that time lag in filling die cavity has been reduced to vanishing point and amount of material introduced into die cavity is exactly equal to amount of material required for part.

C-046
Cochran, R.P., and Curren, A.N.
A Balanced-Pressure Sliding Seal for Transfer of Pressurized Air Between Stationary and Rotating Parts
NACA RM E56I11, Jan. 9, 1957, p. 17

This seal was designed in connection with experimental investigations of air-cooled turbine rotor blades in turbojet engines where high sliding velocities and high ambient seal operating temperatures are encountered; sliding velocities up to 10,000 feet per minute and air pressures up to 38.3 PSIA. Rate of wear on the seal rings was unmeasurable on the inner ring and about 0.0005 inch per hour on the outer ring.

C-047
Coffman, R.T.
Seal for Rotating Shaft
U.S. Patent 2,815, 968 to A.E.C.

A seal is described for a rotatable shaft that must be highly effective when the shaft is not rotating but may be less effective while the shaft is rotating.

C-048 T
Colbey, J.J.
Sealing a Centrifugal Pump Shaft
Power, V. 93, pp. 118-9, Sept., 1949

This is a descriptive article covering stuffing box seals, lantern rings, mechanical seals, and mechanical seals with auxiliary gland packing and vent. Application to centrifugal pumps are considered.

C-049
Colborn, C.E.
Stopping a Turbine Steam Chest Leak by Special Gasket
Power, V. 61, p. 997, June 23, 1925

Brief article describing the reasoning and results of replacing ring gaskets by a full-face gasket. Drawings included.

C-050
Collier, M.
A Feed Screw Powder Seal For The Reactor Tower
Machine Design, V. 31, p.118, Nov. 26, 1959

The two-way sealing of a feed screw for a fine powder conveyor is accomplished with a split gland. The correct installation of the gland is discussed.

C-051
Cosma, G., Lungen, S., Simonescu, C.
Metal-to-Metal and Ceramics-to-Metal Bakeable Vacuum Seals
Am. Vac. Soc., 1961 Trans., Eighth Nat. Vac. Symposium, Second International Congress, V. 2, pp. 1319-1322

Two methods are described for the construction of vacuum tight and bakeable metal-to-metal seals, soldered together with aluminum gaskets. The metal-to-metal seals are lighter, smaller, and cheaper than the usual flange seals with metal gaskets. They can easily be taken apart.

C-052
Conger, C.B.
Piston Rod and Valve Stem Packing
Loc. Engrg., 1500W., July, 1900

Describes the two general types of metallic rod packing in use, and the care it needs.

C-053
Conklin, E. W.
Ceramic Rings Used For Mechanical Rotary Seal
Materials and Methods, V. 45, p. 157, May, 1957

One of the most critical parts in mechanical rotary seals is the rotating seal ring.
Tests were conducted to find materials which would perform better than metal seal rings.
Alumina ceramics were found to make superior rings.
Have high hardness, resistant to all acids except hydrofluoric and strong caustics. Retain full strength to 2000°F and support own weight to 3000°F. Also useful for speeds of 8000 to 20,000 rpm and high pressure uses.

C-054
Connelly, R.E. and Wolf, J.E.
Development of Seals for Rocket Engine Turbopumps
Am. Soc. Lub. Engrs. Trans., V. 2, pp. 25-31, 1959

The design and development of oxidizer, fuel, gas, and oil seals for use in turbo pumps are reviewed. With the following conditions surface speed of 8000 ft. per min; test pressure of 200 psi and face loading of 100 psi.

C-055
Conway, H.G. (editor)
Aircraft Hydraulics VII Component Design
Chapman & Hall, London (TL 697 H9C76a), 198 pp., 1957

Seals, hydraulic pumps and motors; jacks; valves; hydraulic servo-controls; pipe work.

C-056
Cooke, B.
Overheating in Rotary Oil Seals
Engr., V. 187, pp. 223-225, Feb. 25, 1949

Describes temperature measurements made on a rotary seal, which consisted of three parts, namely, a spreading ring, a "U" seal, and a crown header.

Tests specific for crown header. Material neoprene rubber.

C-057
Cooke, B.
Low Pressure Reciprocating Seals for Hydraulic Control Valves
I.M.E. Proc., V. 165, pp. 262-265, 1951

Technique of designing a synthetic rubber lip type of rotary seal so that it is "run-in" on the shaft was applied to finishing the lip of a seal for reciprocating duty.
Paper illustrates that by specially treating a lip seal it is possible to obtain results that have not been equalled. The running-in process used is hardly a production proposition, and some easier way of producing a clean lip must be devised.

C-058 B
Cooke, B.
Pipe Joints For Hydraulic Power Transmission
I.M.E. Proc., V. 164, 3 pp. 308-23, 1951

Vigorous vibration and shock pressure tests, intended to represent the worst conditions possible in marine practice. Test results presented.

C-059
Cooke, B.
Pipe Joints for Hydraulic Power Transmission
Engineering, V. 171, 413-16, 1951

A discussion of the principal advantages and limitations of eighteen different pipe joints, and test results of same. The effect of vibration and shock on joints and sealing materials used.

C-060 B
Cooke, B.
New Gland for Hydraulic Stop Valve Spindles
Engineer, V. 191, 4958, pp. 170-1, Feb. 2, 1951

Short article describes the replacement of normal packed glands on valve spindles by sleeves fitted with O-ring seals. The constant supervision and tightening of soft packed glands is avoided. O-rings successful at pressures of 1500 lbs/sq. in, and do not increase the effort to operate the valve.

C-061
Cooke, B.
Suggestions for Leakage Control in Hydraulic Systems
Applied Hydraulics, V. 6, pp. 38-40, Feb. 1953

Ideas are presented on the proper use of packings which will help one to reduce oil loss and machine downtime.

C-062
Coopey, W.
How To Seal Rotating Shafts Against High Pressures
Chem. Engrg., V. 58, pp. 116-117, July, 1951.

High pressure shaft sealing generally is solved with one of two approaches. Paper describes these approaches and illustrates concepts involved with the description of two rotary seals.

C-063
Coopey, W.
How To Pack Reciprocating Rods Against High Pressures
Chem. Engrg., V. 58, pp. 164-166, Nov., 1951

To design adequately for the severe service conditions found in many high-pressure chemical processes, one must understand and appreciate the fundamental principles of packing. These fundamentals are alignment, quality of materials, finish of materials, lubrication and application. These are individually discussed.

C-064
Coopey, W.
Holding High Pressure Joints
Petroleum Refiner, V. 35, pp. 189-193, May, 1956

C-065
Coopey, W.
How To Solve Soft Packing Problems
Chemical Engineering, V. 65, pp. 131-134, Jan. 27, 1958

Problems attendant to the life of the packing in centrifugal pumps is discussed.
Emphasis is placed on the proper application of the lubricant to critical spots and an attempt is made to remove as many human factors as possible attendant to the original installation.

C-066 B
Coopey, W.
Reciprocating Rod Packings Need Not Be Trouble Spots
Chemical Engineering, V. 68, pp. 113-6, August 21, 1961

Discussion explodes popular misconceptions about packings. Lapped edges, rounded, replace serrated edges of packing elements. Drawings - Conventional vs. Spring-loaded arrangements.

C-067
Cornell, R.L. and Lucas, R.S. and Young, H.L.
Friction and Wear For Water-lubricated Seals
Product Eng., V. 32, pp. 38-41, July 24, 1961

Results of comprehensive investigation of seal wear under boundary lubrication, conducted at Massachusetts Inst. of Technology, indicate that graphite against chrome-plated steel gives best combination of low wear rate and low friction.

C-068
Cornish, H.E., Bloom, J.C.
Development of High Pressure Seals For A.N. Straight Threaded Fittings
Applied Hydraulics, pp. 18-24, Nov., 1949

Describes development and test of an improved O-ring boss seal.
Pressure pulsation tests showed superiority of new design.

C-069 T
Cornish, R.J.
Flow of Water Through Clearances With Relative Motion of the Boundaries
Proc. Royal Soc. of London, Series A, V. 140, pp. 227-240, 1933

Description of experiments on the resistance to flow of water through a series of fine annular clearances in which the cylindrical bush forming the inner boundary could be rotated.

C-070
Corsi, G.L.
Transmission Oil Seals
SAE Paper No. 119u, 10 pp., Oct. 26-28, 1959

Characteristics of silicone polyacrylic (PA-21) and butyl acrylic (BA21) high temperature materials employed in manufacture of seals; progress in mechanical shape of oil seals, when coupled with new synthetic elastomers; advance made in technique of excluding dirt and mud; application information required by oil seal supplier to assure satisfactory performance from selected seal.

C-071 T
Cowie, D.B.
High Vacuum Seal
Rev. Sci. Instruments, V. 15, No. 2, pp. 46-7, Feb., 1944

Wilson's design of vacuum seal with some translational and rotational motion of tubing through a pair of ceramic, or metal plates. 45° bevel on inner faces of the plates retain a neoprene gasket around lead through tubes.

C-072 T
Cowlin, F.J.
The Lubrication of Steam-Turbine Driven Electric Generators
I.M.E. Proc., V. 143, 1940, pps. 83-100, discussion pp. 175-183

Brief review of systems and problems of the lubrication of large steam turbine generators. Discusses general requirements of lubricating systems and components such as coolers, filters, piping, pumps, valves, controls, etc.

C-073 T
Creed, F.R.L.
Liquid Seals For Gas-cooled Dynamic Electric Machines
U.S. Patent 2,805,090, Sept. 3, 1957

A means of sealing a gas-cooled machine by use of oil pressure to force an annular piston with a thrust bearing surface on one end against a collar on the shaft. Oil, not necessarily at the same pressure is pumped to the thrust bearing surface which forms the actual seal.

C-074
Crego, D.F.
Sealing High Pressure Gas
Machine Design, V. 27, pp. 162-168, Sept., 1955

Article reviews characteristics of shaft sealing elements and systems developed for high pressure gases. Discussion specifically concerned with centrifugal compressor applications but designs illustrated have broader implications. Divided into two sections, article deals first with several basic high pressure seals or sealing elements. Then from standpoint of design and application, a number of gas sealing systems, which employ one or more of these fundamental seals, are covered in detail.

C-075 T
Crego, D.F.
Centrifugal Compressors: Seals And Sealing Systems
Petroleum Refinery, V. 34, pp. 143-6, Jan., 1955
Petroleum Engineer, V. 28, pp. C17-22, Feb., 1956

Straight pass labyrinth, staggered labyrinth, segmented carbon rings, and contact or mechanical seals are discussed. Three types of sealing systems, evacuation, gas injection, and fluid injection, are also discussed.

C-076 T

Cronstedt, J.
Turbine Seal
U.S. Patent 2,410,340, Oct. 29, 1946

Labyrinth seal design to eliminate the effects on the seal elements of shaft flexures and heat transfer through the shaft. The rotating seal element is a sleeve which is mounted on the shaft and forms the shaft bearing surface.

C-077 B

Crosland, H.C.
The Effect of Hydraulic Fluids On Synthetic Rubber
Proc. 10th N.C.I.H., V. 8, pp. 190-4, October, 1954

A discussion of the proper synthetic rubber to be used with each basic type of hydraulic oil and the limitations put upon this compatability of rubber and fluid by temperature, pressure, and other conditions of application. Polysulfides, nitrile rubbers, chloroprenes, styrenes, isoprenes, poly acrylates, silicones, trifluorochloroethylene and tetrafluoroethylene resins.

C-078

Cultra, R.A.
Packing For Hydraulic - Elevator Valves'
Power, V. 39, pp. 511-2, April 14, 1914

A description of a method of renewing cup leathers on pilot and main hydraulic elevator valves. Also the manner of making the leather packing cups at the plant. Drawings included.

C-079

Cygan, R.
Project Freeze Seal
North American Aviation Inc., Downey, California
NAA-SR-MEMO-1565 19P. Jan. 25, 1956

Five freeze seal designs for the main SRE pumps were built and tested. The design of seals is presented along with the results of testing.

C-080

Cygan, R. and Stelle, A.M.
Frozen Slugs Seals Shafts
Chem. Engrg., V. 63, pp. 124, 126, No. 3, March, 1956

Operating principle of new seal is formation of barrier between liquid-metal system and outside by freezing slug of metal in narrow passage;frozen metal is held in passage, which is usually annulus, by friction and adhesion.

C-081 T

Cygan, R., Stelle, A.M.
Design and Operation of Freeze-Seal Valves and Pumps
Chemical Engineering Progress, V. 52, pp. 157-9, April, 1956

This article describes the development of such seals for pump and valve shafts. Apparently there is no maintenance needed, provided the liquid metal is prevented from oxidizing by an envelope of inert gas. The starting torque is high, but figures given in the article show that running torque is low if the pressure differential is small.

D-001
Dabney, M.S., Holt, W.W., Jr.
Mechanical Seals Effective on Main Line Pumps
Oil and Gas Journal, V. 49, pp. 57-8, Jan. 4, 1951

A description of test run on mechanical seals as applied to main-line propane pumps is given. Preliminary test on double face seals with seal oil between, lubricated single seals, and unlubricated carbon to metal single seals.

D-002
Dahlstrand, J.Y.
Packing Glands for Steam Turbines
Power Pl. Engng., V. 29, pp. 740-741, July 15, 1925

A discussion of various types of gland packings used in steam turbines and difficulties experienced with each kind.

D-003
Daniels, W.B., and Hruschka, A.A.
Seals for Pressures to 10,000 Atmospheres
Review of Scientific Instruments, V. 28, pp. 1058-1061, Dec. 1957

This note discusses the use of "armored" - O-ring seals for the pressure range to 10,000 atmospheres. In addition a high-pressure pump piston seal and a proprietary surface treatment to reduce liability of galling of steel parts are described.

D-004
Datz, S.
Packing Materials for Hydraulics and Pneumatics
Applied Hydraulics & Pneumatics, V. 12, pp. 115-118, July 1959

Listed are materials marketed for use in hydraulic and pneumatic components along with application information for each type.
Materials include; synthetic rubbers, fluoro-elastomers, polyacrylates, leathers, metals, asbestos. Temperature ratings of each and compatibility with liquids indicated.

D-005
Davenport, F.E.
Pointers on Asbestos Gaskets
Power, V. 83, p. 189, April 1939

Brief directions for their practical use in connection with power plant piping.

D-006 B
Davies, A.J.
A Note on the Use of Polytetrafluoroethylene in Vacuum Seals
Journal Scientific Instruments, V. 35, pp. 378-9, Oct. 1958

A short article describing the procedure used to obtain a seal that may be cooled and reheated repeatedly without deteriorating.

D-007
Davies, H.
Sealing Elements for Rocket Application
Mach. Design, V. 26, 333-4, April 1954

Sealing problems encountered in rocket engines are discussed. Desirable conditions are pointed out. Metal to metal seals, semi resilient seals, resilient seals.

D-008 T
Davies, M.G.
Effect of Eccentricity and Whirl on Back Diffusion in Sleeve Glands
United Kingdom Atomic Energy Authority, IG-R/CA 159, 1959, 18 pp.; also Int. Conf. on Fluid Sealing, Paper C4, April 17-19, 1961, British Hydromechanics Research Assn.

The diffusion of one gas against the stream of another gas, in annular space between a sleeve gland and a rotating shaft is considered. Concluded experimentally, that the simple diffusion theory is inadequate when shaft runs eccentrically or whirls in sleeve; effective length can easily be halved. Explanation suggested.

D-009 T
Davies, M.G.
The Generation of Lift by Surface Roughness in Radial Face Seals
Int. Conf. on Fluid Sealing, Paper E-4, April 17-19, 1961, B.H.R.A.

The idea is developed that large pressures of questionable origin in oil filled clearance between surfaces of radial face seal, is due to hydrodynamic lubrication effects in small wedge shaped cavities constituting surface roughness. The consequence of the theory in regard to leakage and seal design are discussed.

D-010
Davis, P.C., Gore, T.L., Kurata, F.
High Pressure Metal-to-glass Fittings
Ind. Engr. Chem., 43-8, pp. 18, 26-7, Aug. 1951

The fitting described has been designed to seal glass capillary tubing to a metal fitting and to withstand high fluid pressures and vibrations. Sealing is effected by placing an O-ring between the ends of the metal and the glass tubing which is ground square. The tubes are held together by a locking screw. (3000 lbs/sq. in - 400°F)

D-011
Davis, V.H.
Packing That Pump
Southern Power and Industry, V. 59, pp. 68-9, Sept. 1941

Methods for packing pumps and valves given, which may suggest some new ideas in packing procedure.

D-012 B
Dawson, L.J.
Development and Design of Mechanical Seals for Centrifugal Pumps
Ingersoll-Rand, 1950

A description of the origin and development of seals employing radial mating surfaces serves to show which features of the whole gland inherently cause the most trouble. Illustrations and designs.

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D-013
Dawson, P.
Investigation of Cavitation in Lubricating Films Supporting Small Loads
Proc. Conf. on Lubrication and Wear, Paper 49, pp. 93-99, Oct. 1-3, 1957, Instn. Mech. Engrs., 1 Birdcage Walk, London, SW 1

Bearing surfaces in the form of stationary spherical cap and a plane slider have been used to provide visual observations and pressure records of the conditions in the clearance space under full and cavitating conditions. Satisfactory correlation of the pressure records and visual records has been obtained. A departure from predictions is noted in the form of a down stream shift of the oil film rupture point.

D-014
Dawton, R.H.V.M.
High Vacuum Shaft Seals, Flanged Joints and the Gassing and the Permeability of Rubber-like Materials
Brit. Jour. App. Physics, V. 8, pp. 414-421, Oct. 1957

Object of paper is to record the results of some vacuum measurements, e.g., gassing rates and permeability rates, on shaft seals and flanged joints, and also to measure the effect of rubber-like materials when used on continuously pumped high vacuum equipment. Materials tested were rubber type J.1260 from Premier Waterproof and Rubber Co., Ltd.; cured rubber from Greengate and Irwell Rubber Co., Ltd.; neoprene GN from Spencer Moulton and Co.; and butyl of code number Bu 12000, from Firestone Tire and Rubber Co., A silastic gasket was tested at 200°C to 300°C.

D-015 B
Decker, A.L.
Mechanical Seals for Nonlubricating Hydrocarbons
A.S.M.E. Paper No. 57-P.E.T.-2, See also Oil & Gas Journal, V. 56, No. 1, pp. 93-96, Jan. 6, 1958

A brief review of the basic types of mechanical seals, and mechanical seal installations. Test program is described for selection of seals for the less common services. Test group was comprised of 36 centrifugal pumps, 28 of which were handling fluids composed of 90 to 99 percent ethyl chloride, with varying quantities of ethane, hydrogen chloride, and ethylene dichloride.

D-016 T
Decker, A.L.
Sealing of Hazardous Fluids
Int. Conf. on Fluid Sealing, Paper H2, April 17-19, 1961 (6 pp., 2 plates), British Hydromechanics Research Association-Harlow, Essex, England

Paper outlines general types of equipment and methods employed by one chemical company in the handling and sealing of several hazardous fluids. Types of equipment and pertinent features outlined and illustrated.

D-017
Dega, R.L. and Symons, J.D.
Seal Testing to Establish Quality Control Specifications Can Reduce Leakage
SAE Jour., V. 68, pp. 127-128, No. 4, April 1960; SAE Trans., V. 68, pp. 440-447, 1960, SAE Paper No. 130B

Investigation of causes for seal leakage and determination of basic design criteria; major parameters of seal application which affect its efficiency and life as determined by controlled laboratory testing are shaft surface roughness, machining lead, assembly and seal. Most important parameters are seal diameter control, lip pressure, and eccentricity; air gage developed called "Sealector."

D-018 B
Dega, R.L.
Recent Advances in Lip Seal Technology
National Conference Industrial Hydraulics, 14 pp., 154-63, Oct. 1960

Presents the variables which affect seal operation; shaft; assembly; seal, lip dimension variables, diameter, pressure, eccentricities; lip material quality. Also types defects with photos. Presents data curves, temperature vs. speed, hardness variation due to curing time, friction coefficients for various hardness and surface finishes, etc. and discussion.

D-019
Dega, R.L.
Lip Seal Failures - Cause and Prevention
Design News, V. 16, pp. 8-9, June 5, 1961

Establishes that seals leaked because of tolerance excesses in the following lip variables; diameter, pressure, eccentricity, and material quality.

D-020
Deich, V.E., Samoilovich, G.S.
The Comparison of Experimental and Design Data on Leakage Through Labyrinth Seals
(DSIR LVU) (12 pp., 1961) (M3090), Order from OTS or SLA Translation No. 61-27552, Trans. of Mono. Aerodynamic Principles of Axial Turbomachines

Steam turbines, turbines, disks, shafts, gas flow, seals, gas seals, design, tests.

D-021
Dempsey, R.G.
O-Ring Maintenance
Applied Hydraulics, V. 8, pp. 106, 108, 111-113, Oct. 1955

Procedure for obtaining optimum characteristics of packings used in commercial aircraft hydraulic systems; schedule for inspections, replacements, and rework.

D-022 B
Denny, D.F.
Experiments on the Static Friction of Rubber Seal Materials
British Hydromechanics Research Association

D-023
Denny, D.F.
Friction of Flexible Packing
I.M.E. Proc., V. 163, (WEP No. 57) 98-102, 1950

At any time there are anomalies and difficulties in the prediction of friction, and these are accentuated if one of the surfaces is deformable, as in flexible piston seals, since the surface strain introduces an additional variable. Such surfaces, although exhibiting the three usual kinds of friction-dry, boundary, and film, show peculiar characteristics at low speeds, when friction is usually less than at higher speeds. The static friction itself depends on the time which the surfaces have been in contact, and preliminary work indicates that there is a law connecting these two quantities, the probable form of which is given in this paper.

D-024
Denny, D.F.
Experiments on Radial Face Seals
British Hydromechanics Research Association, Report No. R.R. 425, 1952

D-025
Denny, D.F.
The Effect of Shaft Eccentricity on the Performance of Soft Packed Stuffing Boxes
British Hydromechanics Research Association, RR 444, 15 pp., 11 fig., Dec. 1952

Describes experiments with shaft rotated eccentrically by various amounts. Includes a description of test on a device designed to prevent the excessive leakage that accompanies eccentricity.

D-026 B
Denny, D.F.
The Influence of Load and Surface Roughness on the Friction of Rubber-like-materials
Proc. Phys. Soc., B66, pp. 721-7, 1953

Experiments with rubber and gelatin under lubricated conditions confirmed that with rubber-like materials the load dependence of friction is consistent with elastic deformation of surface asperities and partial adhesion over the true area of contact. However, the relation that the friction force is proportional to the two thirds power of the normal load found by previous investigators pertains only over a limited load range. At very low loads the friction is very nearly proportional to load, while at very high loads contact between specimen and track is complete, and the friction remains sensibly constant. Where rubber slides on rough tracks there is a large additional friction force unrelated to true contact area.

D-027 T
Denny, D.F.
The Problem of Fluid Leakage
Fluid Handling, V. 4, pp. 62-64 - March 1953, pp. 92-94 - April 1953, Compressed Air Engineering, pp. 15-21, January 1953

A discussion of reciprocating seals and rotating seals. Included are U-rings, stuffing boxes, synthetic rubber square and round cross section seals. Also circumferential seals, mechanical face seals and oil seals. Presents the operating conditions which can be met with currently available materials.

D-028 B
Denny, D.F.
Tests on Packed Glands for Rotating Shafts
British Hydromechanics Research Association, RR 487, 5 pp., 6 fig., July 1954

D-029 B
Denny, D.F.
Test with O-Rings and Lip Seals on Rotating Shafts
British Hydromechanics Research Association, RR 525, 4 pp., 7 fig., Feb. 1956

Describes some tests made to determine the suitability of O-rings for sealing rotary shafts, when fitted in canted grooves.

D-030 T
Denny, D.F.
A Force Analysis of Stuffing-box Seal
British Hydromechanics Research Association, R.R. 550, 1957

D-031 B
Denny, D.F.
Further Tests on Packed Glands for Rotating Shafts
British Hydromechanics Research Association, RR 561, 3 pp., 9 fig., July 1957

Measurements of fluid pressure gradients have been made on stuffing-box seal fitted to a rotating shaft.

D-032 B
Denny, D.F.
Leakage and Friction Characteristics of Some Single-Lip U-Seals Fitted to Reciprocating Shafts
British Hydromechanics Research Association, RR 595, 8 pp., 16 figs.

Fifteen designs of single-lip U-seal have been compared, for sealing reciprocating shafts against leakage of high pressure oil.

D-033 B
Denny, D.F.
The Work of the Hydromechanics Laboratory With Special Reference to Work on Seals
Proc. 14th British Iron and Steel Research Association (Hydraulics in the Steel Industry), pp. 94-107, disc. pp. 107-8, March 1957

Description of work at the British Hydromechanics Research Association.

D-034
Denny, D.F.
The Lubrication of Fluid Seals
IME Proc. of Conf. on Lubr. & Wear, pp. 392-395, Oct. 1, 1957

Ideally a seal should allow none of the fluid to escape from its container, but with sliding seals, whether for rotary or reciprocating shafts, it is normally necessary to provide reasonable lubrication of the sliding parts if adequate life of seal is to be achieved. Practical implications of the type of lubrication are discussed and it is demonstrated that while no seal can be expected to prevent leakage completely, some by their very nature must allow appreciable leakage flow.

D-035
Denny, D.F.
Recent Research on Hydraulic Seals
Scientific Lubrication, V. 10, pp. 12-17, Sept. 1958

Gives examples of research at the British Hydromechaics Research Assoc. Examples discussed are measurement of rubber friction; striction effect in rubber; leakage of rubber seals; O-rings for rotating shafts and oil-seals for eccentric shafts.

D-036 B
Denny, D.F.
Time Effects in the Static Friction of Lubricated Rubber
Wear, V. 2, pp. 264-272, May 1959

The considerable increases in static friction that occur when lubricated rubber remains at rest under load are shown to be due to squeezing out of the lubricant films from between the surfaces.
The time-scale of the phenomenon appears to be directly related to the bulk viscosity of the lubricant and to the elastic modulus of the rubber.

D-037
Denny, D.F.
Some Measurements of Fluid Pressures Between Plane Parallel Thrust Surfaces and Special Reference to Radial Face Seals
Wear, V. 4, No. 1, pp. 64-83, 1961

D-038
Denny, D.F.
Choosing Right Seal
Hydraulic Power Transmission, V. 8, pp. 32-6, Jan. 1962

Application of appropriate types of seals for cylinder design, characteristics of seal types including metal piston-ring seals, double acting piston seals, etc.

D-039
Denny, D.F., and Turnbull, D.E.
Inverted Stuffing-Box
Engineer, V. 205, pp. 617-618, April 25, 1958

When leakage in a conventional stuffing-box is reduced by tightening the gland bush, there is often overheating, binding and excessive shaft wear. These are usually avoided by permitting a large cooling leakage. However, by inverting the stuffing-box (allowing the packing to rotate with the shaft and the rubbing to take place between the packing and casing) cooling of the rubbing surfaces is greatly facilitated. The inverted arrangement permits operation with a tighter gland bush. Leakage rates comparable with mechanical seals are achieved. Test results are given.

D-040
Denny, D.F., and Turnbull, D.E.
Sealing Characteristics of Stuffing-Box Seals for Rotating Shafts.
IME Proc., V. 174, pp. 271-291, No. 6, 1960

There are two distinct modes of operation of a stuffing-box seal. One mode occurs when the axial pressures produced in the packing by tightening the gland-bush are greater than the sealed fluid pressure and the other when they are less. Under former conditions the fluid pressure distribution is an exponential function of the packed length and the friction torque increases rapidly with this quantity. With high fluid pressures, however, the relation between fluid pressure and packed length is no longer exponential and most of the fluid pressure drop occurs over the last 10 percent of the packed length. In addition very little increase in frictional torque occurs when the packed length is increased. Theoretical expressions derived show good agreement with experimental results.

D-041
D'Eustachio, D.
A Useful Seal for Dynamic Vacuum Systems
Rev. Sci. Instrum., V. 16, pp. 377-8, Dec. 1945

An easily constructed vacuum seal is described. The seal, which uses an ordinary rubber stopper, has been found useful down to 10^{-6} mm Hg. It can be broken and remade rapidly. Precise location within the vacuum system is possible, and the adjustment can be made from outside the vacuum systems.
It has been used for introducing electrodes into, and connecting glass tubing onto dynamic vacuum systems.

D-042
Dezlih, C.J., and Hill, J.J. and others
Design Data for O-Rings and Similar Elastic Seals
Boeing Airplane Co., WADC-TR-56-272(Pt. III), Contract AF33(616)-2867, AD-151181, Feb. 28, 1958, 96 pp., Project 7340

A complete literature survey on O-rings, high and low temperature design, relaxation and volume change tests; with and without back-up rings; etc.

D-043
Diefenbach, G.
Fields of Application for Packings Without Stuffing Boxes. (In German)
Chemie-Ingenieur-Technik., V. 23, pp. 491-4, Oct. 28, 1954

Examples given to show how stuffing boxes can be replaced by automatic spring and slip ring packings; application to pumps, dryers and mixers; illustrations.

D-044 T
Diefenbach, G.
Slide Ring Seals for Rotary Shaft (In German)
Chemie-Ing-Technik, V. 26, No. 7, 1954

Slide ring seals are increasingly used for rotary shafts, because they seal just as well and automatically as gaskets, they can also be used in the case of hard materials. The application of slide ring seals for sealing against pure liquid or homogeneous viscous substances has already been mastered to a very high degree. (Slide ring seals are referred to as mechanical face seals in the U.S.)

D-045
Diegmann, H.
Proper Use of Stuffing-Box Packing (In German)
Maschinenschaden, V. 11, pp. 5-8, 1934

Aspects governing choice of packing; suggestions for carrying out quality tests; packing for wet and superheated steam plants, cold-and-hot water pumps, feed pumps, ammonia compressors, etc.

D-046
Diegmann, H.
Proper Design of Metal Stuffing-Box Packings (In German)
Maschinenschaden, V. 12, pp. 94-6, 1935

With reference to water, steam, gases, liquids under pressure, cooling water, and flue gases, chemical apparatus and machinery and condensers; illustrations.

D-047
Diegmann, H.
New Methods for Manufacture of Stuffing-Box Packings (In German)
Gummi-Ztg., V. 49, p. 496, May 17, 1935

Improvements in design of rapid braiding machines briefly described and illustrated.

D-048
Diegmann, H.
Rules for Application of Various Packing Materials. (In German)
Maschinenschaden, V. 13, pp. 153-5, 1936

Notes on metal base packings for stuffing boxes; steam engines, soft packings according to build up system, asbestos, metal base packings, klingerit packings, installation and replacement of piston rings.

D-049
Diegmann, H.
Series of Exerpiments Regarding Various Packing Materials Functioning under Hydraulic Pressure. (In German)
Werkstattstechnik u Werksleiter, V. 31, pp. 133-6, March 15, 1937.

Characteristics of different packing materials & tabulations of types according to pressure applied; applications.

D-050
Diegmann, H.
New System of Stuffing-Box Design for Movable Machine Parts Using Synthetic Rubber (In German)
Werkzeugmaschine, V. 42, pp. 309-12, July 31, 1938

Various designs illustrated.

D-051
Diegmann, H.
Use of German Materials in Packing (In German)
Schiffbau, V. 40, pp. 83-5, March 1, 1939

Examples of application described and illustrated, with special reference to so-called ferrolastic packing, synthetic rubber packing etc.

D-052
Diegmann, H.
Substitute Materials in Packing (In German)
Kunststoffe, V. 31, pp. 93-6, March 1941, also Glasers Annalen, V. 65, pp. 117-9, March 15, 1941

Synthetic rubber perbunan used for shafting packing instead of leather; comparison between packing properties of leather and its substitute.

D-053
Diehl, K.
Progress in Using Buna Rubber in Engine Construction
PB 24338, Off. Tech. Serv., 7 pp., 1940

This article discusses the most important characteristics of buna rubber, when used for engine construction especially; (1) moisture resistance, (2) heat resistance, (3) mechanical properties, (4) sliding properties, (5) suitability for packing. Finally various types of rubber packings are discussed; especially the heat resisting newly developed B.S. packing. Photographs and graphs are included.

D-054 T
DiPrima, R.C.
The Stability of a Viscous Fluid Between Rotating Cylinders with Axial Flow
Jnl. Fluid Mechanics, V. 9, pp. 621-631, 1960

Attack on stability problem by superimposing a rotationally symmetric disturbance on the steady flow equations. Results compared with those of Kay and Elgan, Fage, Goldstein, and Cormish. Results disagree with last three, but in qualitative agreement with Kay and Elgan. Found that critical Taylor number increases with increasing Reynolds number.

D-055 T
Dollin, F., Brown, W.S.
Flow of Fluids Through Openings in Series
Engineer, V. 164, No. 4259, pp. 223-224, Aug. 27, 1937

Beginning with the general polytropic ideal gas equation, continuity equation, and work-kinetic energy relation, derived a general flow equation. The equations of Martin, Callendar, and Stodola for labyrinth flow as well as flow equations incompressible flow and adiabatic expansion are all obtained from the basic equation. No experimental or design data are given, but the theoretical treatment is straightforward and clear.

D-056
Donald, M.B., and Salomon, J.M.
Behavior of Compressed Asbestos - Fibre Gaskets in Narrow-Faced, Bolted, Flanged Joints
IME Proc., V. 171, pp. 829-833, 1957

To determine the conditions necessary to maintain tightness in narrow-faced, bolted, flanged joints. Experiments were carried out on standard 300 lb. per sq. in., 900°F screwed-on and welded-on flanges fitted to two and one-half inch bore pipes. 'Klingerit,' rubber bonded asbestos gaskets of various dimensions were tested.
Stresses in the bolts were measured with strain-gauges. Results reported.

D-057 T
Donald, M.B., Salomon, J.M.
The Behavior of Narrow-Faced, Bolted, Flanged Joints Under the Influence of Internal Pressure
IME Proc., V. 173, No. 17, pp. 459-468, Nov. 17, 1959

Experimental investigations indicate that during the application of hydraulic pressure to a narrow-faced, bolted, flanged joint; the bolt load can either increase, decrease, or remain constant, depending upon the dimensions and elastic properties of the joint components.

D-058
Dorr, G.N.
Leather Packings for Hydraulic Systems
Product Engng., V. 6, pp. 139-141, April 1935

Grades of leather and design features for various types of leather packings suitable for different ranges of pressure and conditions of service; drawings showing application of U type, split ring, multiple V and concentric ring packings.

D-059
Dorr, G.N.
Packings for Hydraulic Equipment
Mach. (N.Y.), V. 58, pp. 170-175, Sept. 1951

Packings for hydraulic presses, machine tools and other equipment are used in a wide variety of types and different materials for specific purposes. Those used most extensively are described in this article together with recommended applications.

D-060
Dorr, G.N.
Packings for Hydraulic Equipment
Mach. (Lond.), V. 80, pp. 236-239, Feb. 7, 1952

Material from which a packing is made, is also of great importance and must be given careful consideration when selecting seals for any particular purpose. Installation hints given together with operating characteristics of leather as a packing material.

D-061
Doty, W.R.
O-Ring Seals for Glass Apparatus
Review Scientific Instruments, V. 30, pp. 1053-4, Nov. 1959

To construct the joint, glass tubing of the proper size is heated, gathered, and then tooled with forming pliers. The face of the joint contains a groove of the proper diameter and depth to hold an O-ring which makes the seal. Successfully used at temperatures up to 300°C and pressures down to 10^{-6} mm Hg. Drawing, photographs, and specifications for O-ring joint.

D-062
Doughty, L.E.
Composite Elastomer-Metal O-Ring Seals
WADC Technical Report 59-749, Part II, 40 pp. 14 fig., June 1961

A revised fabrication procedure was developed to embed a metal spring concentrically in an elastomer O-ring. Hydraulic dynamic tests were performed at 4000 psi and temperatures up to 500°F. Test results and data presented and discussed.

D-063
Dreibelbis, L.L.
Pressure Traps Between Packings
PB 16610- Off. Tech. Serv., 8 pp., March 19, 1942 (Army Air Forces Expt. Eng. Memo. Rept. EXP-M-51/M752, Add 9)

Laboratory tests are reported on O-ring packings when installing more than one ring on a piston head. As a result of tests it is recommended that O-ring packings be installed with only one ring in each gland, while "V" rings should be installed back to back. Appendix contains table, performance curve, and drawings.

D-064
Dresden, D.
On the Theory of Packing Gland for Reciprocating Machines
Engrs. Digest, V. 11, pp. 342-344, Oct. 1950

Practical information concerning packings for glands can be obtained from standard handbooks. These, however, do not explain why one type of packing is preferable to another under certain conditions. In this article, an attempt is made to develop a theory of the principles involved.

D-065 B
Dunkle, H.H.
Gasket Design and Selection
Proc. 4th National Conference of Industrial Hydraulics, V. 2, pp. 61-71, 1948

Some principles to be observed and practical notes on performance of several types of gaskets are given, but little in the way of actual design.
A classification is given of suitable gasket materials for increasing temperatures, and also of common types of cross-section used.

D-066
Dunkle, H.H.
Gaskets for the Oil Industry
Oil and Gas Journal, V. 49, p. 194+, October 5, 1950, Petroleum Refiner, V. 29, pp. 135-9, November 1950, Abstract; Power, V. 94, p. 136+, November 1950

Description of basic materials used for gasket service in the oil industry: compressed asbestos sheet packing-1/16" thick; corrugated soft iron; corrugated iron jacketed asbestos; spirally wound stainless steel and asbestos; flat iron jacketed asbestos; soft iron ring or octagonal shape. Temperature and pressure ranged indicated.

D-067
Dunkle, H.H.
Metallic Gaskets
Machine Design - The Seals Book, pp. 103-112, Jan. 19, 1961

For any gasket application the choice of material will depend upon the operating conditions, the mechanical features of the flanged assembly, and the gasket characteristics. In general the operating conditions govern the choice of gasket materials and the dimensional and mechanical features of the flanged assembly control the selection of the gasket type.
A guide to be used to determine the choice of the metallic or nonmetallic gasket is covered.

D-068
Dunkle, H.H., and Fetter, E.C.
Chemical and Heat Resistance of Gasket Materials
Chemical Engineering, V. 53, pp. 102-109, Nov. 1946

Gasket constructions in general use and gasket materials both metallic and nonmetallic, their heat and chemical resistance.

D-069
Dunn, R.
Shaft Seal Development Program for the HTGR
Nuc. Sci. Abst. 28388 (Vol. 16, No. 20, p. 3713, Oct. 31, 1962), (Clark Bros. Co., Div. of Dresser Industries, Inc.)

Development of the shaft seal for the HTGR recirculator is reviewed. An interlocking labyrinth was developed which is installed on the shaft from the drive end. This type labyrinth provides a lower leakage rate than straight or stepped labyrinths for a specified shaft size.
Other design aspects are discussed.

D-070
Dunsmoor, R.J., Tipton, F.W.
Testing of Fluid Seals for Extreme Temperatures
Boeing Airplane Co., Proc. of Joint Army-Navy-Air Force Conference on Elastomer Res. & Dev., October 1958

D-071
Dyckes, G.W.
Designing Silicone O-Rings
Rubber World, V. 146, pp. 73-5, April 1962

Information on dimensional stability of molded silicone rubber items, effects of cross section diameters on shrinkage factors, and variation of these factors under normal processing conditions; 7 commercial silicone compounds were investigated, with single compounds of natural rubber, neoprene and butyl rubber for comparison, guide for establishing O-ring tolerances is proposed.

D-072
Dymkowski, J.V.
Pneumatic System Design
Aeronautical Engineering Review, V. 17, pp. 50-55, 66, March 1958

Duct connecting flanges are flat-faced machined bolted type with recessed grooves for O-rings, metallic and silastic, used for sealing. Slip, ball and slip and ball type joints.
Deals with tension and compression type duct system.

E-001 T

Eastman, F.B., McMahon, H.O.
High Temperature Seal for Rotating Shafts
Chemical Engr., V. 54, pp. 157-8, May 1947

Use of teflon shavings dusted with a lubricant such as graphite as a packing for shaft seal. Temperatures up to 700°F are permissible with this packing. Packing must be spring loaded to overcome thermo-moulding of the teflon.

E-002

Eaton, W., Hees, G.W., and Sech, J.
Knife-Edge Vacuum Seal
Vacuum, V. 4, pp. 438-44, 1954

The seal is of a demountable gasket type, made by forcing 2 knife edges into a metal gasket; various knife-edge materials were used including stainless steel, low-C steel, ceramics, quartz and glass.

E-003

Eddy, R.W.
Low Temperature Seals
Chrysler Corporation Missile Division, P 1-31, April 1958

Memorandum describing evaluation of five types of seals to qualify the most reliable for use in LOX lines of Redstone Missile. Includes Norman Coneseal, stainless O-rings, silicone O-rings. Skinner spring seals, temperature compensating coupling stress distribution.

E-004

Edwards, P.L.
Rolling O-Ring Seal
Review of Scientific Instruments, V. 31, p. 1356, Dec. 1960

A very convenient cover and air tight seal called the rolling O-ring seal, is useful where the chamber pressure is below, or only slightly above the outside pressure. Drawing and example included.

E-005 B

Edwards, T.W.
Controlled Leakage Seal; One Answer to High-Pressure Stuffing Box Problems
Power, V. 104, pp. 68-9, November 1960

Editorial article on controlled leakage seal. Solid bushing, and floating ring are the two seal types. Materials, advantages and limitations discussed.

E-006

Edwards, W.L.
Designing Soft Copper Gaskets for High Pressure Equipment
Chem. & Met. Engng., V. 44, pp. 134-137, March 1937

The design and application of soft copper gaskets for sealing various kinds of pressure vessels.

E-007 T

Egli, A.
The Leakage of Steam Through Labyrinth Seals.
ASME Trans., V. 57, pp. 115-122, 1935

Derivation of flow rate equation from Saint Venants equation for a single sharp edge throttling process, as applicable to labyrinth seals. Graphical method outlined, method devised of connection for application to straight-through labyrinths. Test data included.

E-008 T

Egli, A.
The Leakage of Gases Through Narrow Channels
ASME Trans., V. 59, pp. A63-A67, 1937

Resistance coefficient for compressible flow in the annuli. Graphs of pressure ratio vs. dimensionless mass flow. Steam and air leakage test reports, and plots.

E-009 B

Eichenburg, R.
Design Considerations for A.W.H.E.M. 15,000 PSI Flanges
ASME Paper 57-PET-23, 14 pp. inc. 4 fig., Sept. 1957, Mechanical Engineering - V. 80, 3, pp. 66-8 (Condensed), March 1958

This paper provides the necessary information for design of high pressure flanges and gaskets as used by the Standardization Committee of the Association of Well Head Equipment Manufacturers in the design of their 15,000 psi flanges. The design is useful in the extension of the present 10,000 psi API group of flanges to larger size, as required.

E-010

Eiseman, B.J., Jr.
Effects On Elastomers of Freons and Other Halohydrocarbons
Refrig. Engng., V. 57, pp. 1171-1174, 1179, Dec. 1949

A basis for estimating the swelling and elasticity characteristics of gasketing materials.

E-011

Eller, S.A.
Stress Relaxation Versus Seal Ability of MIL-R-900 Gasket Materials
Rubber Age, V. 79, pp. 455-458, No. 3, June 1956

Relationship between stress relaxation and seal aging properties of buna-S stocks, S-3-11 and E-162-1488, compounded to requirements for class 2 material of specification MIL-R-900 and neoprene W stock E-156-575 and buna-N stock E-194-542, compounded to requirements for class 1 and class 5 material, respectively, of specification JAN-R-1149.

E-012 B

Eller, S.A.
An Apparatus for Preparing O-Ring Tensile Specimens
Rubber Age, (NY), V. 84, 5, p. 812, Feb. 1959

E-013

Eller, S.A., and Stein, A.A.
O-Rings for Cylinder Liners of Diesel Engines
Rubber Age, V. 85, pp. 443-448, June 1959

Evaluation of neoprene, nitrile, and silicone, rubber O-rings under conditions simulating service such as in engines aboard naval vessels; load retention properties were higher for nitrile and silicone rubbers than for neoprene; standby service has greater deleterious effect on load retention of neoprene and nitrile rubber O-rings than active service, while for silicone there is little difference.

E-014
Ellis, E.G.
Sealing Problems of High Speed, High Altitude Aircraft and Guided Missiles
Scientific Lubrication, V. 11, pp. 10-12, 14, May 1959

Hydraulic fluids to be sealed are hydrocarbon fluids to 275F, diester blends and silicate esters to 450F, and modified silicones to 700F.
For static seals, O-ring design studies are presented with the following materials: synthetic elastomers, fluoroalkyl silicones; Viton A and Viton A-HV.
On dynamic seals for pneumatic and hydraulic circuits, elastomers may be used up to 120 seconds, but metallic seals must be used for extended running.
Both static and dynamic seals for propulsion systems with high energy fuels, mono-propellants and cryogenic fluids are briefly discussed.

E-015
Elonka, S.M.
Fuel Oil Pumps and Packing
Marine Engineering, V. 44, p. 434, Sept. 1939

Brass fitted pumps should not be used for pumping fuel oil because some fuel oils contain a sulphur base, others an asphalt base. Reasons, corrections, discussions are presented. Operational evidence presented.

E-016 T
Elonka, S.
Fix Seals Before They Knock Out Turbine
Power, V. 95, pp. 112-3, August 1951

Brief commentary on, a) how glands work, b) gland trouble and cures. Maintenance procedure.

E-017 B
Elonka, S.
Manual on Piston Rings
Power, V. 96, 7, pp. 103-26, July 1952

What rings do, guide to ring types, controlling cylinder tube, making emergency rings, liner and piston ring wear, installing and renewing rings.

E-018
Elonka, S.
Gaskets
Power, V. 98, pp. 105-124, March 1954

Author presents a round-up of the latest information on sealing materials and methods, time proven ways as well as new ones.

E-019
Elonka, S.
Mechanical Packing
Power, V. 99, pp. 107-130, March 1955

Article points out that packing is not an exact science since there are too many variables. Experience of engineers and specialists of packing makers, users of packing, and research laboratories where packings have been tested for over thirty years, for packing know how.

E-020
Elonka, S.
Mechanical Seals
Power, V. 100, pp. 109-132, March 1956

Mechanical seals. How they work, materials, finish, cooling systems, selection, installation and care.

E-021
Elonka, S.
This Mechanical Seal Comes Ready to Slide Over Shaft
Power, V. 100, pp. 120-121, No. 12, Dec. 1956

Seal comes fully assembled for direct installation on pump shaft; device known as unitary design, is for pressure to 100 psi, temperatures to 250F and shaft speeds of 4000 fpm. Solves problem of seal faces being damaged by inexperienced help when installing mechanical seal into machine.

E-022 T
Elonka, S.
Not Springs, but Magnets Hold This Mechanical Seal Together
Power, V. 102, pp. 120-1, Dec. 1958

Description of how the seal works. Allows more even seal face pressure so wear on faces is more accurately controlled. Seals used up to 5000 psi, 550°F, speeds up to 20,000 f.p.m. Magnetic shield for gland described.

E-023 T
Elonka, S.
This Mechanical Seal is Also a Pump
Power, V. 103, pp. 220-221, Sept. 1959

Editorial comments on keeping seals cool.

E-024 B
Elonka, S.
Metallic O-Rings Have Come of Age
Power, V. 103, 12, pp. 200-1, Dec. 1959

These rings seal a variety of chemicals, and gasses, i.e., liquid sodium at 1500°F. 0.006" - 0.010" thick resistance welded tube rings. Stainless steel, 304, 316, 321, 347, Monel, Inconel, Inconel X, may be coated with silver, Kel F, or teflon. Basic types, pressures, flange loading. Experimental results.

E-025 B
Elonka, S.
Handbook of Mechanical Packings and Gasket Materials
Mechanical Packing Association, 110 pp., 1960

E-026
Elonka, S.
What's New in Seals
Power, V. 106, 189-93, May 1962

Gaskets: Molded-in-place and pressure-lock types are new.
Fluorocarbon resins team up with inorganic fibers.
Mechanical packings: Rod seal adjust itself; wiper-scraper design is complete in one unit.
Mechanical Seals: Fluid-balanced and welded metal bellows types widen sealing ranges.
Piston rings: Teflon is filled with carbon or glass.
Nylon wear rings also work without lubrication.
O-rings and Lip Seals: Fluoroelastomers, butyl and polyurethanes give rings new temperature scope.
Diagrams, drawings - etc.
Cork and cork rubber, cork and silicone rubber, teflon and asbestos, etc.

E-027

Elsworth, L., Holland, L., and Laurenson, L.
Further Experiences With Aluminum Wire Seals for Bakeable Vacuum Systems
Journal of Scientific Instruments, V. 37, pp. 449-451, Dec. 1960

Aluminum wire clamped between stainless-steel flanges and baked at 300°C formed more adherent joints as the surface finish was decreased from 50 to 10μ in. The Al joint would not cold weld with a force of 4 tons per in. of 20 SWG wire using flanges with a surface finish of 10μ in. and the flanges were indented by the wire. With constant surface finishes, the strength of the Al joint was directly proportional to the baking temperature above a forming temperature (250°C at 10μ in.), and was greatest when the Al wire was perpendicular to the direction of machining marks. Seals made between flanges with a 10μ in. finish had an adhesion strength of 354 lb/in. of wire after forming with a force of 5000 lb per in. of wire and baking at 400°C.

E-028 B

Engelking, F.S., Keys, M.C.
Resilient Face Seals for Tractor Final Drives
S.A.E. Transaction 66, pp. 75-80, 1958

Reports on efficient performance of a tractor final-drive seal, dependent on bellows, bellows-boot operation, seal load and area, seal material, wear washer, and gasket structure.
Curves and test data presented.

E-029

Engle, R.W.
Leaktight Seals for High-Pressure Valves and Piping
Product Engineering, V. 32, pp. 72-75, April 24, 1961

Seal choices for pressures above 1500 psi, and at a temperature range of -20 to 275F.

E-030

Engstrand, W.D.
High Pressure Sealing Fasteners
Assembly and Fastener Engineering, V. 4, pp. 35-37, Feb. 1961

A fastener designed to seal against the leakage of liquid or gaseous media or the transfer of pressure differentials.

E-031

Evans, E.C., Babelay, E.F.
Removable Bowl Cold Trap
Rev. Sci. Instrum., V. 23, pp. 249-250, May 1952

The bowl of the trap has a ground flange at the open end. This flange fits a metal flange of the system's tubulations which retains a neoprene or gum rubber gasket and is sealed to the system by action of the atmosphere. In order to improve vacuum tightness it is recommended to coat the gasket with Apiezon grease.

E-032 T

Evans, R.G.N.
Methods of Sealing Sleeve Bearings
Product Eng., V. 8, No. 3, pp. 110-1, March 1937

Twelve drawings on seals as applied to plain or sleeve type bearings for retaining lubricant or excluding foreign material.
Presentation covers leather packings, bronze rings, "V" formed spreader ring, and labyrinth seals. No technical data.

E-033

Evans, W.P., Landen, E.W.
Radioisotopes Can Do the Otherwise-Impossible; Gasket and Seal Evaluation
SAE Journal, V. 67, 74C-74D, Aug. 1959

A radioactive tracer, cesium 134, was added to the coolant, for an accurate check for leakage into the crankcase, or other leakage paths. Engine parts suspected of allowing leaks could then be autoradiographed on X-Ray film after engine disassembly. Data results, photographs, and curves presented.

E-034

Everett, M.H., and Gillette, H.G.
Squeeze Type Molded Packings
Machine Design, The Seals Book, pp. 68-76, Jan. 19, 1961

Most common type, the O-ring. They work under the principle of controlled deformation. Pressure from the combined fluid produces the deformation which causes the elastic O-ring to seal.
Applications include reciprocating, oscillating and rotating devices.
Operating range -65° to + 225°F for polysulfide polymer and -130°F or lower and as high as 500°F for silicone polymers.
Hexafluoropropylene and vinyldene fluoride copolymers are also used. They show excellent resistance to a great number of fluids and chemicals, -40°F to 600°F.

E-035

Everett, M.H. and Gillette, H.G.
Static O-Ring Seals
Machine Design, The Seals Book, pp. 100-102, Jan. 19, 1961

All static O-ring seals are classified as gasket type seals. Easier to apply than dynamic O-ring seals. Pressures as high as 25,000 psi can be sealed. Once the O-ring is installed, the operating pressure keeps the O-ring sealed against the metal clearance areas. Some types of silicone materials will function within the -130 to +500°F range.

E-036

Exline, P.G.
Leakage in Capillary Seals of Hydraulic Valves and Pumps
Prod. Engng., V. 17, pp. 290-296, April 1946

Formulas for calculating the volume of leakage of viscous fluids through concentric and eccentric radial clearance spaces are given.

F-001
Faber, P.
Designing Labyrinth Stuffing Boxes For Steam Turbines
Power, Sept. 8, 1908

Gives a method for calculating packings of labyrinth stuffing boxes, graphical solution.

F-002
Fabian, R. J.
Materials For Gaskets, Packings And Seals
Mat. in Design Engrg., V. 50, pp. 111-126, Dec., 1959

Hundreds of materials and composites are available for sealing fluids under static or dynamic conditions.

F-003
Fairbanks, F. L.
Packing For Ammonia Compressor Stuffing Boxes
Power, V. 43, pp. 179-81, Feb. 8, 1916

Various kinds of ammonia packing are illustrated and described. An asbestos fabric and rubber, self-centering ring is a sensitive and excellent packing. A fibrous sectional wedge ring with cushion gives good service on the rod of a pump discharging 200 gal. per min. of anhydrous ammonia, 24 hours per day, with no odor of ammonia at the stuffing box or from the rod.

F-004
Faley, R.L., Long, J. F.
High Temperature Seal For Gas Chromatography Detectors
Analytical Chemistry, V. 32, p. 302, Feb., 1960

Describes the modification of the Crawford Swagelok tube fittings to mount a gas chromatography hot wire detector. Temp. up to 500 C, and pressure to 50 psig

F-005 T
Fanestiel, A.
Mechanical Shaft Seals For General Refinery Service
Oil and Gas Journal, V. 49, pp. 56-61, Feb. 1, 1951

Discussion of application of three seal types to refinery service: stuffing box with cage ring, double mechanical face seal with seal oil between, and single mechanical face seal.

F-006 B
Farman, R. G.
Studies Of Relaxation Characteristics Of Non-metallic Gasket Materials
India Rubber World, V. 123, 5, pp. 679-82, & 685, March, 1951

Describes a relatively simple apparatus designed for determining the relaxation characteristics of gasket materials at room and elevated temperatures to stimulate actual field conditions.
Data curves presented.

F-007
Farnsworth, S. H.
Metallic Packing For Valve Stems
Power, V. 41, 648, May 11, 1915

A modification of packing on Corliss type valve stem.
Drawings for two types

F-008
Faunce, S.F.
Metallic Seal And Gland For Static Sealing Applications In Aircraft Power Plant Fluid Systems
WADC Tech. Rpt. 56-378, June, 1956

F-009 T
Fawcett, J.R.
Fluid Seals For Rotating Shafts
Mech. World Engr. Record, V. 130, No. 3369, pp. 121-5, Aug. 10, 1951

The choice of seals to prevent lubricant from escaping along a rotating shaft depends on the nature of fluid, its pressure and temperature, shaft speed, and permissable leakage. Discussions of seal arrangements, to give protection in two directions and synthetic rubber oil seals with reinforcing washer to withstand higher pressures are included.

F-010 T
Fawcett, J.R.
O-Rings And Their Application
Machinery (London) V. 82, No. 2108, pp. 677-8, April, 1953

Article discussing efficiency and requirements of effective sealing up to 40,000 lbs. per sq. in. pressures. Ratios for size, hardness and housing finishes discussed.

F-011 B
Fawcett, J.R.
Pressure Seals For Reciprocating Parts
Hyd. Pur. Transin. Part I - V. 1,2, pp. 97-100 - Feb., 1955
Part II- V. 1,3, pp. 154-57 - Mar., 1955
Rotating Seals Part III - V. 1,5, pp. 293-5, May, 1955
Part IV - V. 1,6, pp. 249-52, June, 1955

F-012
Fawcett, J.R.
Pressure Sealing By O-Rings
Engineering, V. 185 pp. 314-315, March 7, 1958

Static O-ring applications are illustrated with pressures to 3500 lb. per sq. inch.
Dynamic applications are also discussed together with their limitations.

F-013
Feather, L.E.
Gasketed Joints For Electrical Equipment
Product Engineering, V. 28, pp. 183-188, March, 1957

Requirements imposed on gaskets and gasketed joints for all types of electrical equipment are so diverse that no single gasket material can be used universally; in fact, the ideal material is seldom found for any application.
Choice of material and joint design involves four basic criteria; these togehter with specific gasket materials are discussed.
Application suggestions are likewise covered.

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F-014

Fedor, J.V.
A Sommerfeld Solution For Finite Bearings With Circumferential Grooves
A.S.M.E. Paper No. 59 - Lub - 4, 6 pages

The author develops a method of solution of the Reynolds differential equation for full journal bearings that circumvents the usual algebraic complexity. The bearing considered by the author is similar to a buffered bushing type seal. Calculation of bearing end flow.

F-015

Fekete, K.
Similarity Considerations For Radial Face Seals
Escher Wyss News, V. 34, No. 2/3, pp. 46, 47, 1961

The characteristic non-dimensional parameters or dynamic similarity criteria of the radial face seals can be determined by dimensional analysis. Formula development, schematic drawings, test results, data curve are presented.

F-016

Felter, L. E.
Babbitt Packing For Steam Joints
Popular Mechanics, V. 34, 448-9, Sept., 1920

F-017

Fenner, A. J., Willoughby, G.
Gas Seal For High Temperature Extensometer Tensile Tests In Inert Atmospheres
Journal Scientific Instruments, V. 31, pp. 472, 3, Dec., 1954

A silicone rubber moulding closes the lower end of a tube, and stretched over the lower straining bar of the machine. The extensometer arms are then passed one by one through the appropriate rectangular apertures and attached to the ends of the test piece. 400°C for 100 hours, 600°C for 70 hours. Discussion, data curve and photo.

F-018

Field, H., Jr.
Design Of Hydraulic Systems, Packings And Their Application
Product Engineering, V. 16, pp. 100-4, February, 1945

The problem of selecting a fluid seal or packing is is discussed as to materials, types available, purpose of the seal, installation problems, and advantages and disadvantages of each type of packing. Compression packing, U-cup packing, V-ring packings, O-ring packings, high pressure packings. Asbestos, yarn, cotton yarn, hemp, cork, leather, rubber, lead, tin, graphite, etc. used separately and combinations. Drawings and detailed descriptions.

F-019

Finkel, J.
Schwabe Stuffing-box
Zeitschi. Vereines Deutsch Ing., V. 47, pp. 1049 - 1051, July 18, 1903 (communicated at the meeting of Westfälisches Bezirksverein Nov. 18, 1902)

In this stuffing box, specially designed for high pressures, and super heated steam at 320°C, the packing rings are made of cast iron owing to the ease with which this acquires a fine glass-hard polish. Five or more such rings, split at three places on the periphery, are carried enclosed between outer cast-rion rings in the chambers bored out for them, play in all directions in the plane of the rings being obtainable. A device is shown by which the leakage past such a stuffing box is measured on a high-pressure cylinder. The mean temperature of the interior of the cylinder was 225°C. Diagrams show the pressure and temperature distribution in the stuffing box.

F-020 T

Fisher, E. W.
Considerations In The Development Of Roll Neck Oil Seals
Iron & Steel Engr., V. 27, 5, pp. 92-5, 96-8, May, 1950

A brief review of some of the failures and limitations of lip garter seals, and considerations for improvement.

F-021

Fisher, E. W.
Seals And Closures
Lubrication Engrg., V. 9, pp. 190-194, Aug., 1953

Seals and closures retain lubricants in bearings. Two general classifications (a) contact and (b) non-contact. Examples are given of each type and advantages and disadvantages of each are listed together with design considerations. New synthetic materials listed are silicone rubber and teflon, advantages and disadvantages of each are given.

F-022

Fisher, E. W.
Packing Construction Is Usually Tailored To The Specific Application
The Plant, V. 15, pp. 57-59, May, 1957

Braided packings for shaft seals; their construction, materials and applications. Types discussed are fiber, including jute, cotton, ramie, rayon and flax; asbestos; metal braids; teflon plastic; asbestos plus teflon; fiber plus rubber; metal foil wrapped around fibrous or non-metallic cores; "plastic" packing, called plastic because it is formable and not because of its material; and ring packings.

F-023

Fisher, E.W.
Take Care Of Oil Seals For Longer Bearing Life
Iron Age, V. 181, pp. 110-111, March 13, 1958

Recommendations on the handling of oil seals prior to installation are made together with general installation and maintenance instructions.

F-024 T

Fisher, M.J.
An Analysis Of The Deformation Of The Balanced Ring In High Pressure Radial Face Seals
Intl. Conf. on Fluid Sealing, Paper D4, April 17-19, 1961
British Hydromechanic Research Association, Harlow, Essex, England

The deformation has been determined by applying cylindrical shell theory, and for a particular seal it is comparable to that of the stationary carbon face. It is shown that this deformation depends markedly on the position of the static seal between the ring and the shaft.

F-025
Fitch, L.E.
Development Test On Hydro-Pneumatic Equilibrators For 155 MM Gun Carriage M1,(2nd Report, 30th Report On Ordnance Program No. 5084)
P.B. 33947, Off. Tech. Serv., 47 p. Oct., 1943

Tests were made to determine the effect of subzero temperatures on the functioning of the complete hydro-pneumatic equilibrators and the effect of the loss on hand wheel efforts. A comparison of hydro pneumatic equilibrators having standard silver packings, with pneumatic equilibrators having experimental neoprene packing, indicated that the latter are superior both in design and performance. Drawings and photographs are included.

F-026
Fitts, J.S.
Testing Of 304 Stainless Steel Metal Boss Seals
General Electric Co., Aircraft Nuclear Propulsion Dept., Cincinnati, Ohio
DC60-2-112, Contract AT(11-1)171, Feb. 9, 1960, 18P

A series of tests were performed to determine the sealing effectiveness and reusability of MS24382 304SS metal boss seals. Operating pressures up to 3000 psig and at -65 to 600°F.

F-027 B
Fletcher, P. J.
Assessing The Performance Of U Rings Used As Piston Seals In Hydraulic Pit Equipment
Hydraulic Power Transmission, V. 3, 33 pp. 534-9, Sept. 1957

F-028
Flick, F.
Hydraulic Seals
Machine Design, V. 20, pp. 139-44, Nov., 1948

Factors to consider in selecting sliding types of packing for hydraulic cylinders of types used in machine tools; development of leakproof seal assemblies; discussion of seal types, efficiency, cause of chatter, advantages of cup seals, metallic seals, piston rod seals and static seals.

F-029
Fornesi, R.
Mechanical Seals For Slurry Service
Industrial & Engrg. Chemistry, V. 51, pp. 59A-60A, Nov. 1959

A slurry is a mixture of a liquid and undissolved solids, either amorphous or crystalline. Amorphous solids are usually not abrasive but will gum up seal springs. Springs must be located out of contact with such slurries. Crystalline solids are usually abrasive. Three mechanical dynamic seal configurations are presented for abrasive slurries: (1) a single seal with a clear liquid injected at a pressure slightly above the pressure on the stuffing box, thus isolating the seal from the abrasive pumpage; (2) double seals, one at each end of the stuffing box with an outside source of liquid to lubricate the seal faces from within the seal cavity; (3) single seal with a quench style gland for use only with slurries where abrasive conditions are caused by contact of the liquid with the atmosphere.

F-030 T
Forrest, J.
Oil Seals For Rotary Shafts
Trans. of the Institute of Rubber Industry, V. 20, pp. 212-214, 1945

This paper records advances made in the use of molded synthetic rubber sealing members.

F-031
Forrester, P.G.
Frictional Properties Of Oil Seal Materials
Engrg., V. 164, pp. 121-124, Aug. 8, 1947

Tests were made to determine amount of friction between an oil-seal lip and the rotating land for restricted areas of contact and low sliding velocities. The oil seal materials used were four types of leather and two types of synthetic rubber and three lubricants of standard service grade.
Experimental results are shown in table form.

F-032
Forrieres, R.
Deterioration Of Rubber Gaskets
Gas Journal (London), V. 207, p. 362, Aug. 15, 1934

F-033
Forte, T., Harrington, D.B
Demountable Metal Vacuum Seal
Rev. Sci. Instr., V. 28, pp. 585-6, July, 1957

Flanges are serrated on their inner surface, and are mechanically bonded to the pipe by expanding the pipe into the flange. A small length of pipe is allowed to protrude beyond the flange, and the diameter of this short length is fixed accurately during the simple expanding process by using a retainer plate. The seal is made by pinching a 0.20" flat ring of 2S aluminum between the turned ends of the pipe.
Rubber, teflon, copper, silver, or gold may be used.

F-034
Fox, Z.
Seals For Preventing Oil Leakage In High Speed Superchargers
Prod. Engrg., V. 17, pp. 158-162, Feb. 1946

Methods of preventing oil leakage through openings for shafts in gear cases and bearing housings of high speed superchargers where pressure differentials exist across the seal.

Design features and performances of ring, labyrinth and contact types of seals are discussed and their relative advantages compared.

F-035
Frazier, E. C.
Design For Economical Gasketing
Prod. Engng., V. 22, pp. 139-144, July, 1951

The design, selection of material, and manner of specifying gaskets has a significant effect on joint cost and effectiveness. Factors involved are charted and illustrated to further the discussion.

F-036
Frazier, E. C.
New Paper Materials Find Use In Gaskets, Oil Filters, And Embossed Sheeting
Mat. & Methods, V. 38, pp. 92-93, Aug., 1953

A new family of paper materials composed of fibers, synthetic rubber or resins, and sometimes ground cork, have been developed by Armstrong Cork.

F-037
Frazier, E. C.
How To Select, Specify And Use Nonmetallic Gaskets
Mach. Design, V. 26, pp. 158-188, Nov., 1954

Manual deals specifically with gaskets. Its purpose is to give specific design guidance in their selection and use. Fundamental principles of gasketing are stressed, and significant characteristics of the numerous available gasket materials outlined. Materials covered are principally those having a broad field of use, as contrasted to specific purpose materials.

F-038
Freedman, R. A.
What You Should Know About O-Rings For Air And Oil Circuits
App. Hydraulics & Pneumatics, V. 12, pp. 128-130, July, 1959

From maintenance standpoint, O-rings involve problems of hydraulic leakage and pneumatic lubrication; maintenance inspection of seals revolves around two questions; how many drops of fluid must seep past hydraulic O-ring before they indicate objectionable leak and how must air seep past pneumatic O-ring before there is indication of damage; to understand hydraulic problem of leakage and pneumatic problem of lubrication, it is necessary to consider special features of O-rings separately.

F-039 B
Freeman, A. R.
Gaskets For High Pressure Vessels
Mechanical Engineering, V. 74, 12, pp. 969-72, Dec., 1952

The gaskets described in this paper are suitable for pressures of the order of 50, 000 lb/sq. in. The most successful seals ensure that the contact pressure is increased as the fluid pressure increases. Rubber O-rings, delta rings, and other gaskets also described.

F-040
Freeman, A. R.
Eight Gaskets For High Static Pressure
Product Engrng. Annual Handbook, J. 30- J. 33, 1955

Methods of sealing the heads of vessels subjected to high static internal fluid pressure are described.

F-041
Fremlin, J. H.
A Quick Release Seal For Vacuum Desiccators
J. Sci. Instrum., V. 29, p. 236, July 1952

Many all-glass vacuum desiccators are sealed simply by greasing the surface of the lid and the body. After evacuation, and in cold weater, it is often difficult to remove a lid sealed in this manner. The use of a rubber ring is suggested stuck to one of the surfaces between the lid and body. The rubber, compressed during sealing, expands slightly after release of the vacuum, and consequently the lid can be lifted away freely. Rubber of 40 Shore hardness should be used.

F-042
Fremlin, J. H.
A Flexible Vacuum Joint
J. Sci. Instrum., V. 29, p. 267, Aug. 1952

Design developed which provides for a flange on the main vacuum system, and a flange on the moving shaft, joined by a length of rubber tubing, which is supported internally by a helical wire spring. The rubber tube is clamped to the flanges by brass bands. A floating ring in the tube prevents it from collapsing. Butyl rubber with a leak rate of 0.05 microliters per sec were used. The diameter of the hub should be 10% smaller than the system, and shrunk on to the flanges.

F-043
French, E. P., Newton, A.
A High Vacuum Rotary Seal
Nucleonics, V. 10, p. 66, Mar. 1952

The seal consisted essentially of a rubber diaphragm clamped between the upper and lower half of the housing, the center of which allowed a wobble shaft connecting the driving shaft on the atmospheric side with a driven shaft on the vacuum side to pass. The seal was effective down to a pressure of 3×10^{-5} mm Hg.
Drawing included.

F-044
Froede, W. G.
Seals Among NSU Developments On Rotating Combustion Engines
S.A.E. Journal, V. 69, pp. 50-56, April, 1961

Reports progress on seals for Wankel engines, as well as on spark plugs cooling, fuel consumption and overall durability. Drawings, data curves, pictures.

F-045 T
Frolich, M.
Turbine For Cooling A Fluid By Expansion
U.S. Patent, 2, 910, 328, October 27, 1959

Design provides a labyrinth which can be supplied with gas from an accumulator upon stopping the turbine. This prevents hot oil vapor from leaking from the bearing cavity into the turbine.

F-046
Frossel, W.
Hydrodynamic Shaft Seals
Engrs. Digest, V. 18, pp. 18-20, Jan.,1957

Describes a threaded shaft seal providing sealing by dynamic means, without wear and with minimum friction, as there is no direct contact between the stationary and rotating parts. Although primarily developed for liquids, this seal, fitted in a sleeve is also suitable for gases. Tests were run at speeds of 100 to 2000 rpm. Seals only when equipment is running.

F-047 T
Frossel, W.
High Speed Lubricating Oil Pump (in German)
Konstruktion, V. 12, No. 5, pp. 195-203, 1960

Determination of the effect of thread form on the viscosity type pump. The application was for lubricating oil pumps for high speed machinery. Tested V thread, trapezoidal thread, truncated threads, each in three sizes, 0.03 to 0.5 mm, clearance at 1500 to 15, 000 rpm, in 50 mm dia. pump. Surface speeds were 3.93 to 39.3 mps, oil viscosity 20 cs at 20°C. Test results shown.

F-048

Fujiwara, E. J. and others
Compounds For High Temperature Fuel Seals
Rubber Age, V. 82, pp. 1016-1020, No. 6, March, 1958

Apparatus for determination of physical properties of elastomeric materials at temperatures to 400°F. While immersed in aircraft fuels; machine incorporates fixed metal bellows filled with hydraulic fluid as unit in which pressure will reflect stress applied to O-ring; of materials tested, Viton A vulcanizates appeared to be of most interest for high temperature seals.

F-049 T

Fuller, D. D. (Editor)
Gas Lubricated Bearings
Proc. First International Symposium on Gas-lubricated Bearings, Office of Naval Research, ACR-49, Oct. 26-28, 1959

Twenty papers on gas-lubricated bearings. The appendix B is a revised version of "A Bibliography on Gas-lubricated Bearings" by E. B. Sciulli.

F-050 B

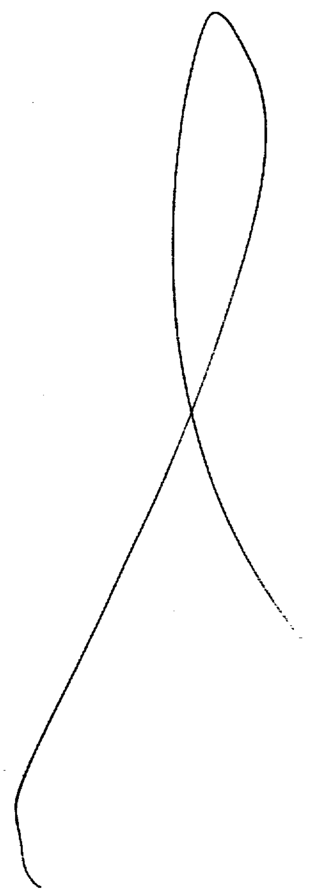
Furuhama, S.
A Dynamic Theory Of Piston Ring Lubrication
Bulletin of Japan Society of Mechanical Engineers
Part I - V. 2, 7, pp. 423-8, 1958 (Analysis)
Part II - V. 3, 10, pp. 291-7, May, 1960 (Experiment)

It has been found that at high engine speeds the oil film between a piston ring and the cylinder wall is not ruptured at T.D.C. when the piston speed is zero.

F-051

Fuschillo, N.
Sliding And Rotating Mechanical And Electrical Feed-through Seals Into A Vacuum
Am. J. Phys., V. 26, p. 400, Sept., 1958

Low cost rubber seals for use in vacuum systems at pressures down to 10^{-6} MM Hg are described. The seals permit almost unlimited rotational and longitudinal freedom as well as provide a reliable and easily demountable feed-through system for electrical connections.



G-001 B

Gahus, J.
Centrifugal Pumps In The Chemical Industry
Chimie et Inc., V. 63, 1, pp. 34-9, Jan. 1950 (In French)

This article is a discussion of packings for centrifugal pumps used in the chemical industry and the author shows that from a common sense point of view as well as from experience pump stuffing boxes should be allowed to leak. Use of the radial-face seal (mechanical) is advised in the most difficult cases where leakage is unacceptable.

G-002 B

Galloway, C.W.
Evaluation Of High Temperature Hydraulic Seals To Temperatures Of 550°F - Part I Mechanical Evaluation
W.A.D.C. Tech. Reports 57-76, 143 pp., Feb. 1958

Report describes test to evaluate and develop seals for use in hydraulic systems using OS-45 or MLO-8200 fluids at temperatures of 400°F and 550°F respectively. The scope of the program includes seals of various shapes and forms as well as their method of installation and the material from which they were manufactured.

G-003

Galloway, C.W.
Designing A Seal For The DC-8
Hydraulics and Pneumatics, V. 14, pp. 89-91, Feb. 1961

Description of a teflon slipper seal with a square rubber loading ring, developed to prevent leakage of hydraulic fluid in the DC-8 landing gear.

G-004

Galpern, H.N.
Aircraft Gasket Compounds
Rubber Age, V. 90, No. 4, pp. 621-626, Jan. 1962

An evaluation of the compatibility of a fluorocarbon elastomer with various silicone lubricants under a wide range of temperature conditions.

G-005

Garba, J.
Preliminary Evaluation Of Helium Couplings For The 6K Motor
Jet Propulsion Laboratory, P 1-3, April 21, 1959

Seals, O-ring design, and test of special O-ring tube joint.

G-006

Gardner, A.R.
Beat The Heat With Pyrolytic Graphite
Prod. Engng., V. 33, pp. 72-75, Jan. 22, 1962

High temperature strength and two kinds of electrical and thermal conductivity make this a material to watch.
Chart compares its properties to tungsten, copper, stainless steel (310) and commercial graphite.

G-007

Gardner, D.B.
Recirculating Water Systems And Mechanical Pump Seals
Air Conditioning, Heating & Ventilating, V. 57, pp. 57-9, Dec. 1960

The performance of mechanical pump seals can be controlled by certain application and installation procedures which can be utilized in both closed and open recirculating water systems. Seal failure cause and prevention. Photograph examples of seal failures. Carbon and ceramic mating rings.

G-008

Gardner, W.W., and others
Hydrostatic Thrust-Type Shaft Seal For Hydrogen-Cooled Generators
Power Apparatus and Systems (AIEE Trans.), V. 78, pp. 653-659, Aug. 1959

The seal is essentially a hydrostatically lubricated thrust bearing in which the thrust load to be supported by the oil film consists of the spring force, the force produced by the hydrogen pressure acting on the end of the seal ring, and the O-ring and support-pad friction forces resulting from axial movement of the shaft. These forces are balanced by the oil film pressure distribution maintained by the oil-supply system at the face of the seal. The seal has a babbitted face. It is suitable for hydrogen pressures above 30 psi and up to 75 psi.

G-009

Garner, L.P.
Machined Metal Stuffing Box Seals Adapted To High Vacuum Technique
Rev. Sci. Instruments, V. 8, pp. 329-332, Sept. 1937

Vacuum seals machined from metals and adapted to vacuum technique are described and shown in several forms suitable for joining metals and glass components. Precautions in construction and use are given. Dimensioned working drawings for several sizes of one type are shown.

G-010

Garrod, R.I.
A Compact Sliding Vacuum Seal
J. Sci. Instrum., V. 28, p. 187, June 1951

The author describes an O-ring type of joint allowing for translatory movement. The flange of one of the two pipe sections is fitted with a V-shaped groove to accommodate the O-ring. The flange of the adjoining pipe section is recessed over a certain width of the flange, to a depth that 7 percent compression permits the two flanges to touch.

G-011

Gartmann, H.
Boiler Feed Pumps For Supercritical Pressure
Mech. Engng., V. 80, pp. 51-54, Jan. 1958

Seals for a high pressure pump in a 125,000 kw steam plant designed for a supercritical steam pressure of 4500 psig are discussed.
The sealing of the high pressure pump, with its suction of 2065 psig and 510.9°F temperature, required careful consideration.
The seal bushings selected were of the floating type with a close tolerance between the shaft and bushing, and a large clearance between the bushing OD and the surrounding housing. One end was sealed by a lapped radial face against a matched face in the case. Satisfactory results are obtained when a fluid having good lubricating properties is used as a sealing medium.

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G-012
Garvin, J.M.
Designing A Seal For Very High Pressure
Applied Hydraulics, V. 10, pp. 141-145, May 1957

To seal 45,000 psi. Careful consideration must be given to every detail of design and construction. Starting with the basic principles of seals and weighing every step on the way.
Step-by-step description of how such a problem was solved, with insight into some of the reasons why packings work or fail.

G-013
Gastineau, R.L.
Hollow Metallic O-Rings
Machine Design, The Seals Book, pp. 113-114, Jan. 19, 1961

Hollow metallic O-ring gaskets possess certain characteristics under operating conditions that static rubber O-rings do not. Under very high pressures, clearances for rubber O-rings must be prohibitively small to prevent rubber extrusions. Temperatures are limited to temperatures below the decomposition temperature of the rubber. At the other end of the scale, under a high vacuum,rubbers give off gases of their own, thereby destroying the vacuum.

G-014
Gel'man, L.J.
Centrifugal Pump For Amalgam
Order from OTS or S.L.A. - Translation No. 61-27179

The construction of shaft packing for centrifugal pump was made for the purpose of eliminating contact between the amalgam and atmosphere's air and test was made to determine the efficiency of pump shaft packing.
Experimental data.

G-015
Gerberich, D.E., Kurlovich, D., and others
Experimental Investigation Of Optimum Inclosure For "O" Section Synthetic Rubber Seal Ring
WADC Tech. Report 53-319, Aug. 1953

G-016 T
Gercke, M.J.
Flow Through Labyrinth Packing
Die Warme, V. 57, pp. 513-517, 1934
Abstract-Mech. Engn.,V. 56, pp. 678-680, 1934

A flow equation is derived by considering a series of nozzles. The final equation does not assume constant flow area, but if constant area is assumed, the result is identical to Martins equation. The use of the equation under different operating conditions is discussed, and the influence of a direction of flow with radially arranged labyrinths is considered.

G-017
Gercke, M.J.
Labyrinth Packings and Centrifugal Force (In German)
Waerme, V. 58, pp. 529-34, Aug. 17, 1935

Analysis of effects of centrifugal force on flow-through packings as basis for quantitative determination of effect in any particular case, taking steam pressures into consideration, special reference to steam-turbine packings.

G-018
Giaimo, E.C., Jr.
Ring-Type Teflon Gasket
Review of Scientific Instruments, V. 26, p. 520, May 1955

The gasket consists of a teflon ring, machined in from the edge resulting in a "U" shaped cross section. A toroidal helical spring is loosely laid in the groove around the outside of the ring. After the initial loading has taken place, the spring becomes partially imbedded in the teflon, which prevents it from moving. The sealing action is accomplished by producing a radial force as a result of an axial one. Design data and service results presented, as well as drawing.

G-019
Gilchrist, R.R.
Application Of Cold Drawn Seamless Steel Tubes For Hydraulics
Compressed Air & Hydraulics, V. 23, pp. 159-163, No. 263, Feb. 1958

Discussion of seamless hydraulic ram cylinder manufacturing methods, surface finishing techniques, seal types, performance, and operating characteristics; dependence of operating cycles, on surface finish, and effect on seal failures; recommended surface finish tolerance for medium and heavy duty cylinders.

G-020
Gilhart, J.S.
Graphite-To-Metal Seal Screening Tests
Babcock and Wilcox Co., Atomic Energy Div., Lynchburg, Va., BAW-1053, Contract AT(30-1), 1940, 21 pp., Sept. 1958

A seal which will hold bismuth with a practical interface contact pressure was developed between graphite and steel.

G-021
Gill, J.S., Marshall, W.L.
High Pressure Vessel Incorporating A Teflon Gasket For Use To 500°C And 1000 ATM
Rev. Sci. Instrum., V. 32, No. 9, 1060-2, Sept. 1961

A small vessel is described, believed to be leakproof at a temperature of 500°C and at the hydrodynamic pressures up to 1000 atm. Details of the design are given and the use of the vessel in the determination of solubilities in aqueous systems is described.

G-022
Gillespie, L.H.
How To Design With Teflon Packings
Applied Hydraulics and Pneumatics, V. 12, pp. 121-124, July 1959

Advantages of teflon for seals are; its almost complete chemical inertness, wide useful temperature range, and the lowest coefficient of friction of any solid material. Since no lubrication is needed, a possible source of contamination is removed.
Design considerations are given for using teflon in lip seals of the Cup, Rod, U, and V-ring types; also for squeeze-type seals of the square, wedge, and O-ring types.

G-023 B
Gillespie, L.H.
How To Design With Teflon Piston Rings
Appl. Hydraulics and Pneumatics, V. 12, 10, pp. 128-30, October 1959

Article covers properties, starting friction, design factors, reinforced resins, piston ring wear, tolerances and finishes, and rotating seals.

G-024
Gillespie, L.H.
Mechanical Seals - Design, Materials, Installation
Applied Hydraulics & Pneumatics, V. 13, pp. 90-92, Feb. 1960

Brief description of the various types of dynamic shaft seals and a short glossary of dynamic seal terms.

G-025
Gillick, T.J., Jr., and Magnant, F.J.
Synthetic Fiber Felt
Prod. Engng., V. 28, pp. 178-182, July 1957

Properties of synthetic felts for filters, seals, wicks, and gaskets at service temperatures above 200°F; major types are simple interlock, woven insert, prestretched and shrunk, and thermoplastic bonded; tables show tensile strength and elongation of fibers; effect of structure on properties; coefficient of friction of synthetic fiber felts against glass, deformation and set at 58.6 psi load, wicking and oil absorption and physical properties of seven fibers.

G-026
Giordano, F.
Less Leakage Now With Shaft Seals
Product Engineering, V. 31, p. 15, Dec. 19, 1960

New seal design and a new method of finishing the surface of a rotating shaft have combined to reduce seal leakage at high pressures and operating speeds. The back up ring is prevented from rotating, but free to move a small distance radially. The back up ring, therefore, tends to follow rather than oppose shaft movement. Test results discussed.
Drawing included.

G-027 T
Glaeser, W.A., Allen, C.M.
The Friction And Wear Of Refractory Materials For Use In High Speed Mechanical Seals
Int. Conf. on Fluid Sealing, Paper F2, April 17-19, 1961 (30 pages), British Hydromechanics Research Association, Harlow, Essex, England

The role of physical properties of ceramic and cermet materials in relation to their high speed, high temperature friction, wear, and surface degradation, as applied to unlubricated radial face-seals. Speeds up to 360 ft/sec. temp. 1000°C.

G-028
Goldoftas, T.
Shape Of Seals
Hydraulics and Pneumatics, V. 14, pp. 75-82, Nov. 1961

Tabular charts listing seals by shape, and divided into elastomeric, leather, and metallic seals. These charts are limited to pressure sealing types for static and reciprocating applications. Chart information includes fluid medium, temperature ranges for various seal materials, maximum pressure, surface finish required, and seal size range.

G-029
Gough, H.J.
Pipe Flanges, Research Committee, First Report
I.M.E. Proc., V. 132, pp. 201-340, 1936

The experiments reported fall into four distinct but related groups. Test made to determine the limiting pressure conditions necessary to maintain tightness of a joint at air temperature, the behavior of metal joints, reinforced asbestos packings, metallic-packing rings, and corrugated sheet have been studied. Assemblies of studs, bolts, nuts, and washers have been subjected to prolonged loading at 975°F and their contribution to the total creep deformation studied. The elastic flexibility of two pair of flanges for 8-inch pipe has been determined. Tests have been made on complete steam pipe assembly curves, data, diagrams, etc.

G-030
Gould, J.R.
Water Seal For Stirrers Used In Mixer-Settler Type Extractor
Knolls Atomic Power Lab., Gen. Elec. Co., Sch'dy., N.Y., KAPL-104, Contract W-31-109-Eng., Jan. 30, 1956

A water seal was developed to prevent vapor leakage out of the mixer shaft standpipes of a horizontal mixer-settler type extractor.

G-031
Graham, J.W., and Zimmerman, W.F.
What's Happened To Cermets?
Metal Progress, V. 73, pp. 89-91, March 1958

A cermet is a metal ceramic combination. Developed as a material which would combine the strength of the metal with the heat resistance of the ceramic.
Al_2O_3 bonded by chromium resisted oxidation up to 2200°F for long periods and 2750°F for shorter periods. Titanium carbide and chromium combinations were also tried. These were successful between 1400°F and 2000°F.
Zirconium boride cermets are not attacked by molten aluminum.
Nuclear energy applications include fuel elements, control rods, bearings and seals in alkali-metal heat transfer media.
Systems for handling liquid fuels for rocket propulsion have made use of their unique properties, especially in seals at necessary joints or glands.

G-032
Grasby, R.C.
Seals For Passenger Car Automatic Transmissions
SAE Paper, No. 715, 4 p., April 16, 1956

Seals fall into two groups; spring loaded oil seals for rotating shafts, and synthetic rubber cup packings for activating clutches; new materials on which there has been test or production experience are silicone rubber, polyacrylate rubber, butyl-acrylate rubber, and teflon; so called piston packings or lip seals, are basically synthetic rubber cup packings.

G-033 T
Grasby, R.C.
Seals For Passenger Car Automatic Transmissions
SAE Journal, V. 64, pp. 20-1, October 1956

Four new seal materials show promise in seals for automatic transmissions. Silicone, polyacrylate rubber, butyl-acrylate, and teflon are discussed as to their advantages and limitations.

G-034
Gray, S.
Bearing And Seal Development
Mechanical Engng., V. 81, pp. 76-80, April 1959

Study of a high-speed rotating-face-type shaft seal normally used to seal the jet fuel in an aircraft pump. The seal is required to operate dry at an overspeed of 13,000 fpm and at 500F. Then it returns to its original jet fuel operation with no decrease in sealing efficiency. For rotors of titanium and tungsten carbide, seals of the same carbides and also of "1000-F" carbon graphite were tested, with test results tabulated. (In the ASME paper, but not in the condensed version, the development of a Freon-12 shaft-seal design for an aircraft-type refrigeration compressor was discussed.)

G-035
Green, L.A., Miles, H.T., Richardson, A.C.
A Dismountable Vacuum Joint For Bakable Glass Systems
Journal Scientific Instruments, V. 36, pp. 324-325, July 1959

Describes a joint in which a metal gasket can be used between glass tubes without the need for a metal flange; the area of metal exposed to the system gas is thus kept to a minimum. The joint is based on a type made commercially for joining sections of glass pipeline. A butt joint is made between two glass tubes of the same diameter by compressing a wire ring between the ground ends of the tube.

G-036
Green, R.A.
Test Of Packing Rings Proposed For Use In The B26 Airplane Main Landing Gear Retracting Strut Swivel Joint
PB 30514, Off. Tech. Services, 6 p., March 1942, (Army Air Corps Material Div., Memo. Rept. Exp. M-51/B840)

The result of life and sealing tests of hydraulic packing rings. The packing rings were confined to "U" cup rings. Table and schematic diagrams are included.

G-037
Greiner, H.F.
Rotating Seals For High Pressure
Product Engng., V. 27, pp. 140-143, Feb. 1956

Mechanical seals offer solutions to many extreme operating conditions where conventional packings may prove unsatisfactory.
Design factors are discussed.

G-038
Griffis, C.B., Javier, V.S., Wilson, A.
Dynamic Properties Of Elastomers At High Temperatures
Qm. Res. and Engr. Command, Proc. Joint Army-Navy-Air Force Conference on Elastomer Res. and Devel., Oct. 1958

G-039
Griffiths, C.A.
Measuring Packing Performance By Work-Factor Method
Power, V. 71, pp. 905-907, June 10, 1930

Various testing machines used to duplicate exact service conditions. The objective in simulative service tests is, obviously, twofold: (1) to weed out unsatisfactory material, (2) to evaluate material which has otherwise met certain minimum requirements; comparison on test data given in chart form.

G-040 T
Grinnell, S.K.
Flow Of A Compressible Fluid In Thin Passages
ASME Trans., V. 78, No. 4, pp. 765-771, May 1956

The author rederives the expression by which the data for Fanno flow in the Gas Table are tabulated. A simplified analysis is presented where momentum effects are negligible. Valid for height to length ratios of less than 1/1000. Experimental and comparison data graphically presented. Discussion by Hughes is appended.

G-041
Griswold, G.Z.
Selecting Seals And Packings
Mach. Design, V. 11, pp. 34-38, May 1939

Unit bearing seals-assembled and self-contained parts made for a variety of comparatively standard applications are discussed in this article. A few are: spring-loaded radial type, non-spring loaded, various face seals, seal friction; bearing overload.

G-042 T
Grobel, L.P.
Shaft Seal
U.S. Patent 2,314,207, March 16, 1943

This presents a shaft seal design for application to gas filled dynamo-electric machines. The seal, which is situated adjacent to the main rotor support bearings, consists of a non-floating buffered bushing in which the sealant fluid is introduced between two non-rotating seal bushings.

G-043
Groddeck, K.H.
Problems Of Noncontacting High Pressure Stuffing Boxes (In German)
Forschung and dem Gebiete de Ingenieurwesens, V. 23, pp. 183-95, 1957

Investigation of flow in vortex chambers of labyrinth packings; formulas developed for calculating flow velocities at inlet of sealing slits, and leakage; advantages of new type of stuffing box which permits reciprocal movement of stationary and rotating parts of seal in axial direction; means of reducing leakage in condensing steam turbine.

G-044 T
Groves, G.A.
Study Of Package Seal Housing Design For Liquid Buffered Floating Bushing Type Seals
Oak Ridge National Laboratory, CF61-11-42, 16 pp. Nov. 28, 1961

The study compared package seal design with a seal where cavity and service lines are designed as an integral part of the machinery structure. It is necessary however, in most cases to apply the design concept in the initial design of the rotating machinery.

G-045
Grunwald, H.H.
Glands For The Entry Of Electrical Cables Into Pressure Vessels Containing Or Surrounded By Conducting Liquid
I.M.E. Proc., V. 172, pp. 487-498, 1958

Paper concerned with the theory, design and construction of seals through which one or more electrical conductors pass into vessels containing or surrounded by, non-insulating liquids under pressure.

H-001
Haakonson, A.
Brake Device Working On The Fluid Brake Principle
Trans. of Norwegian Patent 44/909/26-58
(A. Capelo - PO Box 46354 - Hollywood 46, Calif.)

Hydraulic Brakes, Seals

H-002
Haas, M.
Packings For Pistons And Valves
Review de Mechanique, 3500 W, Sept., 1898

Discussing especially piston packings for marine engines, operating with high pressure steam, with many illustrations of actual packings.

H-003
Haas, W.
Integrated Seals Simplify Tartar Design
Space/Aeronautics, p. 89, 90, 92, April, 1959

Description of gland-type, mechanical, integrated seals that are used on the Tartar missile.

H-004
Haberman, N.
O-Ring Test Report
G.E. Co., Aircraft Nuclear Propulsion Dept., DC-59-10-15, Contract AT (11-1)-171, 14 p., Sept. 30, 1959

High temperature and radiation testing of silicone rubber O-rings which are used as pressure seals in the XMA-1A shim scram actuator disconnect coupling is discussed.

H-005
Haenle, S.
Contributions To The Strength Behavior Of Flanges With Welded Neck And The Evaluation Of The Sealing Forces Of Some Soft Gaskets On The Asbestos Basis
Forchung auf dem Gebiete des Ingenieurwesens, V. 23, Ausgabe B, No. 4, pp. 113-34, 1957

A method of calculating the strength properties of bolted flanged connections with consideration of the applied screw forces and of the initial pressure.

H-006
Hagerty, W. W.
A New Factor In The Design Of Hydraulic Seals
Proc. Nat. Conf. Indust. Hyd., V. 1, pp. 122-129, Oct. 16-17, 1947

Paper describes a method of sealing a rotating shaft against leakage caused by an axial pressure gradient. In first part of paper the general theory of fluid motion encountered is presented.
In second part manner in which the theory is applied to the problem is demonstrated and some general examples of seal design are given.

H-007
Hagerty, W. W.
Designing Hydraulic Seal
Applied Hydraulics, V. 1, pp. 26-7, 30, Feb., 1948

Essential features of method of sealing rotating shaft against leakage caused by axial pressure gradient; general theory of fluid motion encountered; application of principles of fluid mechanics; development of sealing element; general design examples and applications of resulting hydraulic seal.

H-008
Hall, C. C.
Care Of Metallic Packings
Paper, V. 28, pp. 17-18, April 13, 1921

H-009
Hamkens, H.
Steam Engine Operation And Maintenance, Piston Rod Packing
Power, V. 52, p. 621, Oct. 19, 1920

Discusses some forms of soft packings, their limitations and application; also soft metals and cast iron packing rings. Describes care to be taken when fitting rings. Drawings included.

H-010 B
Hamlin, C. E.
Seals, The Vulnerable Giants
SAE Paper 50S, 6 p., 7 fig., April, 1959

The effects of pressure, temperature, and unusual fluids on present-day seals are described together with some of the recent research work which is being done in these fields. Diagrams of various types of back-up rings are shown including the delta and bimaterial and channel.

H-011
Hamlin, C. E.
Backup Ring Design Affects O-Ring Life
SAE Jour., V. 67, pp. 81-82, May, 1959. Abstract of SAE Paper 50S, "Seals, the vulnerable giants," April, 1959

Effect of various configurations of backup rings on life and proper sealing of Viton A O-rings at high temperatures.

H-012
Hamlin, C.E.
Metal Hydraulic Seals May Be It
SAE Jour., V. 67, pp. 62-63, June 1959. Abstract of SAE Paper 50S, "Seals, the vulnerable giants," April, 1959

Metal piston and shaft seals for high temperature hydraulic systems are better than elastomers for thermal cycling and high pressures but are more difficult to design. Natorq static boss seals of stainless steel, Inconel X, and aluminum are leakproof from -360 to 1000F and 5 to 10,000 psi for liquids and gases such as silicate esters, liquid oxygen and hydrogen, anhydrous ammonia, etc.

H-013
Hammond, R.
Sealing A Rotating Shaft
Chemical Age, p. 199, Aug. 17, 1946

The design configuration on a shaft seal involving a metal bellows is presented.

H-014
Hanson, A.C. and Inman, G.O.
Limitations Of Tin As Packing Material
Indus. & Eng. Chem., V. 31, pp. 662-3, June, 1939

Allotropic transportation on bearing surfaces of tin racking causes leakage; addition of bismuth in tin will increase hardness and decrease elasticity to marked degree.

H-015 T
Hanson, O. P.
Mechanical Seals For Rotary Shafts
Research, V. 12, pp. 61-67, 1959

Fundamental principles of mechanical seals are discussed by the progressive development of a definition of a mechanical seal. Particular attention given to individual components, balancing, face pressure conditions, arrangement, limitations, and capabilities.

H-016 T
Harney, D. B.
Shaft Sealing Device With Standby Seal
U. S. Patent, 2,818,286, Dec. 31, 1957

This is a packing gland to be used as an inactive standby seal. The packing is prevented from activation by a split annular ring, allowing the use of the packing compression sleeve and its flanges as the mount for the normally activated outer seal.

H-017
Harper, D. B.
Seal Leakage In Rotary Regenerator And Its Effect On Rotary-Regenerator Design For Gas Turbines
Trans., ASME, V. 79, pp. 233-245, Feb., 1957

An analysis of rotary-regenerator seal leakage is presented which predicts the leakage quantity and the variations of pressure gradient under the sealing shoe. The verifying results obtained from tests of a simulated sealing arrangement also are given.

H-018 B
Harrington, R.
How Hot Water Affects Elastomers
Rubber Age (NY), V. 84, 5, pp. 798-811, February, 1959

H-019
Hart, L. P.
Compressibility Of Composition Cork
Elec. Wld., V. 118, p. 1640, Nov. 14, 1942
Information on the properties of composition gaskets for liquid filled electrical equipment.

H-020
Hart, L. P. Jr.,
Evolution Of Transformer Gaskets
General Electric Review, V. 53, pp. 34-41, June, 1950

1) Behavior of rubber-like materials in oil and Askarel
2) Nitrile rubber compounds
3) Contamination
4) Mechanical properties
5) Compression set
6) Permeability to water vapor
7) Service tests
8) Application
9) Summary

H-021
Hartz, F. J.
Crane Company Seal Leakage Program
Westinghouse Electric Corp., Atomic Power Division, Contract AT-11-1-GEN-14, Subcontract 73 (14-349), Jan. 31, 1955. 11 p.

A program was initiated to compile test data on conventional sealing materials and to investigate methods of operating valves wherein forces must be transmitted through a pressure wall. Test results, descriptions of apparatus and measuring techniques, and conclusions and recommendations are included

H-022
Hatfield, N. J.
All Metal Reed Seal Evaluation For 0-3000 psig Pressure, Hydraulic Service
PB-125883, Off. Tech. Serv.

Evaluation tests of all metal reed seals were performed during the first quarter of the year 1955. Leakage rates and total leakage were accurately measured while the test shaft cycles through the reed seals. Physical wear on the seals was determined. At temperatures of 30°F, test results indicate the feasibility of using an all-metal reed seal in aircraft hydraulic systems at normal operation pressures up to 3000 psig. AD 97637, Proj. No. 1371, Contract AF 33(600) - 28968, WADC TR 55-302.

H-023
Hayman, R. L.
O-Ring Packings Adapted For 3000 lb. Pressures
Prod. Engng., V. 16, pp. 56-58, Jan. 1945

A successful method of utilizing synthetic rubber O-rings in reciprocating hydraulic equipment at double the maximum pressure previously considered practical is described.
Problem solved by using leather backing rings on both sides of the O-rings.

H-024
Hayman, R. L.
Performance Of O-Ring Packings In Rotary Seals For 3000 lb. Pressure
Prod. Engng., V. 16, pp. 190-191, March, 1945

Most frequent application in aircraft hydraulics is on swing joints, a term applied to line joints subjected to rotary action. Generally used in lieu of a high pressure hose.
In developing and testing O-ring seals for swing joints, the largest diameter swing joint required in a 3000 psi application was selected as the critical member. Two test joints were constructed to same dimensions. Results of tests given.
Tests are also described on a single O-ring seal at 0-3000 psi., pulsating pressure, at a rate of pressure increase of 200,000 psi per sec.

H-025
Haynes, W. B.
Use Of Metallic Gaskets
Power, V. 47, p. 906, June 25, 1918

H-026
Hayward, A. G.
Simple Rotary Vacuum Seal
J. Sci. Instr., V. 29, p. 410, Dec. 1952

A 1/16-inch neoprene washer with a central hole and lubricated with Apiezon wax is held against a threaded circular base by the rim of a shaft through the central hole of the washer. The shaft is held in position by a knurled nut screwed onto the circular base and locked by a knurled screw.

H-027
Hayward, A. G.
Simple Vacuum Seals
Vacuum, V. 11, No. 3, pp. 262-264, July, 1952

Describes four types: a) simple rotary seal, b) seal for continuous rotation, c) seal for current lead, d) air leak seal
Neoprene washer; ring, ball, and washers supporting pieces. Drawings included.

H-028
Headrick, R. E.
Composite Seal Materials For Extreme Environments
Wright-Patterson Air Force Base, Aeronautical Systems Div., Tech. Doc. Rept. ASD-TDR - 62 - 286, 23 p., Mar., 1962. Also SAE Journal - V. 70, pp. 58-63, Oct. 1962

Evaluation of metal fiber skeletons impregnated with softer organic and inorganic materials, as seals at both static and dynamic conditions, from liquid nitrogen temperatures to 1000°F, and at pressures up to 5000 psi, have yielded unsurpassed results. The metal fiber skeletons (stainless steel or molybdenum) provide the strength and resilience, and the impregnating materials (soft metals, soft metal alloys, or compounded polymeric materials) provide the sealing barrier. In some cases the impregnants have increased the resilience and lubricity of the composite. The limitations, potentials, and the availability of these materials are discussed.

H-029 B
Heaps, N. B.
How To Extend Centrifugal Pump Life Erosion, Packings And Bearings, Causes And Cures.
Chemical Engineering, V. 66, 11, pp. 128, 130, 132, June 1, 1959

A number of considerations for erosion, packing, and bearings, cause and cures.

H-030
Hearst, J. R., Ahn, S. H., Strait, E. N.
Vacuum Seals At Liquid Nitrogen Temperatures
Rev. Sci. Instrum. V. 30, No. 3, p. 200, , Mar., 1959

O-rings made of Kel-F elastomer have been found satisfactory at liquid nitrogen temperature. Recommended sizes and application techniques.

H-031
Heathcote, V. A., Read, W. E.
Demountable Seal For High Vacuum Work
Jour. Sci. Inst., V. 34, p. 247, June, 1957

Standard copper steam jointing rings, manufactured by Hulburd Patents Ltd., were compressed between two steel flanges and the space between the contact edges evacuated by means of a rotary oil pump. The seals could be baked for prolonged periods at 450°C without showing any sign of leak. Test data and drawing included.

H-032
Hees, G. W., Eaton, W., Lech, J.
The Knife-Edge Vacuum Seal
Vacuum, V. 4, No.4, pp. 438-441(Oct. 1954; Pub. June 1957)

A reliable high-vacuum sealing technique of wide applicability and capable of containing an ultra-high vacuum is described. This seal can readily be assembled or disassembled. It can withstand repeated and prolonged bakeouts as well as liquid nitrogen temperatures. Seals ranging from less than one inch to more than twelve inches in diameter have been constructed. A wide variety of materials have been joined.

H-033 B
Heffner, F. E.
A General Method For Correlating Labyrinth Seal Lake Rate Data
A.S.M.E. Paper No. 59 - Lub - 7, 8 pages, Oct., 1959, See also ASME Trans., Journal of Basic Engineering, V. 82, No. 2, pp. 265-275, June, 1960

Method for correlating test data which allows calculation of gas leak rates for an entire family of labyrinth seals, from test of two characteristics; accuracy three-percent. Two dimensional graphs are plotted for simultaneous solution. Valid for both staggered and straight-through labyrinths.

H-034 T
Heher, W. M.
Determination Of Coolant Loss Through Double Gland Turbine Seal
Goodyear Atomic Corporation, G.A.T.-T.811, 5 pages, May 27, 1960

An infra-red analyzer is arranged as a detector for leakage of a refrigerant from power recovery turbine seal. The method of leak measurement during seal test is discussed.

H-035
Heher, W. M.
Development And Performance Of The Prototype Seal For The Power Recovery Turbine
Goodyear Atomic Corporation, Report GAT-388, 17 pages, May 12, 1961

A double-gland, positive contact seal was developed for use in a power recovery turbine operating on coolant 114 vapor (dichlorotetraflourethane). The average leak rate during 12,500 hours of successful operation was 0.235 pounds per day.

H-036
Heinrich, J. T.
Simple Vacuum Coupling
Rev. Sci. Instrument, V. 29, p. 1053, Nov., 1958

Work with metal vacuum systems often requires a coupling that is readily machined, quick to assemble, and does not pose difficult alignment problems. Such a coupling may be fashioned from a standard flare fitting. Fittings are selected 1/8" larger than the OD of the tubing used. The conical surface of the male portion is machined to form a flat face. Greased O-ring is pressed against the flat surface and the tube by gasket (which is stock part in flare fittings) and a flare nut.

H-037
Heizen, M.B.
Desert Tests (1952) Experimental Oil Filter Gaskets, PB 159 620, Off. Tech. Serv., 31 p., 2 ref., 23 Sept., 52. (Rept. 39 on Proj. No. T.B. 5-1401, Aberdeen Proving Ground)

Eight experimental gaskets were installed on trucks ranging in size from 3/4 ton to 5 ton. These trucks were operated approximately 10,000 miles each in ambient temperatures as high as 123°F. Only one oil filter element change was made on each vehicle during the course of operation, but at the conclusion of the test the gaskets were not considered serviceable for additional use.

H-038
Hemeon, J. R. and others
Leakage Control
App. Hydraulics, V. 10, P. 53 between p. 81 and 168, No. 5, May, 1957

The following are included:
What they say about leakage control
Practical design ideas
Testing packings
Port seals
How O-rings seal air and oil components
How teflon packings behave
Designing seals
Control of contaminants
Static sealing with metal O-rings
Selection of flareless fittings, etc.

H-039
Hemphill, J. W.
Packings For Power Plants
Nat. Engr., V. 41, pp. 678-80, Dec., 1937

Suggestions regarding important factors to be considered in selection of packings; hints on construction of stuffing boxes; application of packing.

H-040 B
Hemphill, J.W.
Do's And Don'ts Of Packing Practice
Paper Mkr. & Brit. Paper Trade J., pp. 37-8, 40, 42 Midsummer, 1951 (Reprint from Paper Industry USA)

Practical advice on obtaining the best performance from gland packings. Every gland should be looked upon as an energy-absorbing unit and thus should be adjusted so that the power loss is a minimum.

H-041
Hepworth, J.L.
Sealing Rings For Wet Cylinder Liners
Sci. Lubrication, V. 9, pp. 24-26, No. 3, March, 1957. Also abstract in Chartered Mech. Engr. V 4, pp. 20-21, No. 1, Jan., 1957

Three basic types of wet liner for engine cylinders; only types X & Y are considered, these being sealed at top by compression of flange, while lower end is sealed by rubber rings; functions of sealing ring; measurement and calculation of wall pressure; results of tests and design data; sealing ring material and ring finish; method of assembly.

H-042
Herle, F.
Novel Design Of Metallic Packing Stands Test Of Time
Power Plant Engineering, V. 29, p. 915, Sept. 1, 1925

Assembled segments of metallic packing, cast from babbitt, interlock and are held together by coil springs. Still operating successfully after ten years.
Drawings of construction detail and assembly.

H-043
Heyer, K.
Testing Sealing Agents For Pressurized Cabins
Lilienthal Ges Luftfahrtforsch, p. 56, Rept. 29
Spec. Libr. Assn. Trans. 3214 (17p), V. 3, No. 8, Aug., 1957

H-044
Heywood, W. A.
Report On Static Seal Test
Knolls Atomic Power Lab, General Electric Company, AECD-3081, March 12, 1951

Tests were made on a gasket-type seal of neoprene rubber. From 4 to 12 standard 1/2-13 holddown bolts in steps of 2 were tried. Data given on tests.

H-045
Heywood, W. A., and Hilbert, C. J.
Control Rod Gas Seals
Knolls Atomic Power Lab., General Electric Co., KAPL-669, Jan. 14, 1952

Apparatus designed to test gas seals for the KAPL Intermediate Power Breeder reactor control rods is described. Specifications and drawings of the seals are included and test data given.

H-046
Heywood, W. A.
Frozen Sodium Shaft Seal
Knolls Atomic Power Lab., General Electric Co., KAPL-1265, Contract W-31-109-Eng-52. Aug. 4, 1954

The feasibility of using a frozen sodium annulus as a shaft seal was investitaged. The torque required to turn a shaft in a frozen annulus, the leakage of sodium past a frozen annulus was studied.

H-047
Heywood, W. A.
Control Rod Gas Seals
Knolls Atomic Power Lab., General Electric Co., KAPL 1161, Contract W-31-109-Eng-52, Jan. 25, 1955, 12 p.

The experimental work to develop a seal with a H_e leak rate of less than $2x10^{-6}$ cc/min is described, and the mechanism controlling the lower leak rate limit for elastomer seals is demonstrated.

H-048 T
Hibbard, R. L.
Carbon Bearing Seals
Materials and Methods, V. 45, pp. 110-114, March, 1957

The three types of carbon generally used for bearings and seals are pitch coke-bonded lamp black, pitch-coke bonded graphite, and impregnated graphite. Properties of carbon are compared with other materials and areas of superiority outlined. A guide to the design of carbon bearing and seals is included.

H-049
Hildenbrand, J. L.
SAE Jour., V. 65, pp. 78-79, Sept. 1957. Also in Soc. Automotive Engr. Paper - N21, Jan. 14-18, 1957

Research and development program for improvement of bearing seals for track rollers of crawler tractors; study carried out over five years at International Harvester Company; factors in design of test equipment to evaluate seal characteristics; three stages of laboratory tests and field tests.

H-050 B

Hill, M.
Performance Tests Of Seals, Oil, Plain Or Plain Encased For Shaft Sizes 0.875, 2.625, and 3.50 inches
NAVORD Reports 5529-5531 and 5533-5534, Apr-May, 1958 (Pbs 143236-143240)

Five reports describe results of leakage rate and torque tests on a range of lip seals made by five different U.S.A. seal manufacturers. Operating conditions described 70° - 74°F, - 20 to -65°F, 2000 ft/min., eccentricity (shaft) 0.008 on 3.5 in. dia.

H-051

Hill, R. M.
Cork-Rubber Materials
Product Engrg., V. 10, pp. 239-241, June, 1939

Various applications of cork-rubber compositions, load deflection properties; molded packings for use in both static and dynamic sealing; illustrations of types.

H-052

Hinkle, R. J.
What The Users Of Mechanical Packings And Rubber And Asbestos Products Should Know
India Rubber W., V. 82, p. 65, Sept. 1930

H-053

Hinkle, R. J.
Designs For Applying Press-Fit Seal Units
Product Eng., V. 12, pp. 370-1, July, 1941

Sketches showing how bearings seal units of standard bore simplify bearing design and lower costs.

H-054

Hintenberger, H
Experience With Metal Foils As High Vacuum Seals
Zeits fur Naturforschung, 6A, pp. 459-462 (7p) 1951
Spec. Lib. Assn. Translation #1800, (7p), V. 3, No. 1, Jan., 1957 (AEC-tr 2554)

Details are given of the performance of aluminum foil as a packing material for vacuum tight flanged pipe joints. The design of the flanges and the processing of the foil necessary to give satisfactory results is discussed. The joints can be exposed to ordinary baking temperature up to 280°C.

H-055 T

Hirano, F., Ishiwata, H., and Kambayashi, H.
Friction And Sealing Characteristics Of Oil Seals
Int. Conf. on Fluid Sealing Paper A4 (24 pages) April 17-19-1961, British Hydromechanics Research Assoc. Harlow, Essex, England

Much experimental data on friction and leakage in lip seals and mechanical face seals.
Hydrodynamic analysis
Shaft speed, leakage, friction, seal size, shaft surface roughness, surface pressure and its distribution, are among variables discussed and related.

H-056

Hobbs, R. B.
A Study Of Specifications For Chrome-Tanned Hydraulic Packing Leather
J. Am. Leather Chem. Assoc., V. 41, pp. 573-90, 1946

Variations in the requirements of Federal specifications are discussed. The results of tests of 6 com. leathers are presented.

H-057

Hobline, L.E., Humphrey, S.A., Dinsmon, T. E.
Kinetic And Static Friction Of The O-Ring Type Gasket
PB-120850, Off. Tech. Serv., 29 pgs.

Survey was undertaken to provide supplementary data on the character of the frictional forces to expect when employing O-ring type gaskets, and the results are presented in the form of design work sheets. (NAVORD 2281)

H-058

Hodder, B.H.
Vacuum Or Low Pressure Seal Utilizing Modified Standard Refrigeration-Type Flare TubeFittings
Journal of Scientific Instruments, V. 35, p. 182, May, 1958

The modification comprises a groove machined in the flare fitting to retain standard neoprene O-ring packings. The tube flare is then screwed up to touch the flare fitting. The O-ring is compressed in the groove and the seal made. Drawings and table of relevant dimensions and details for flare fitting modification.

H-059 T

Hodkinson, B.
Estimation Of The Leakage Through A Labyrinth Gland
I.M.E. Proc., V. 141, pp. 283-288, 1940

Reviews methods of calculating leakage for labyrinth seals. Test results presented graphically in the manner of Elgi. Stationary labyrinth test. Analysis assumptions are reviewed and examined for error.

H-060

Holden, J., et al.
Bakeable Vacuum Seals Using Aluminum-Wire Gaskets
Jour. Sci. Inst., V. 36, pp. 281-283, June, 1959

Static seal for use up to 550°C. It is used between steel flanges. Gives information on the minimum compression force which must be applied to an aluminum wire in order to form a cemented joint at elevated temperature.

H-061 T

Hollander, A., Hoover, V.A., and others
Liquid Seal
U.S. Patent 2,295,579, Sept., 15, 1942

A seal for a vertical shaft in which mercury is used as the sealing means. A cup-shaped container rotating with the shaft is filled with mercury. An annular baffle secured to the stationary housing extends downward into the mercury isolating the interior and exterior portions of the housing. A means is provided to keep the mercury in contact with the shaft, opposing the effect of centrifugal force.

H-062 B

Holoubeck, F.
Transitional Frictional Effects In Powered Controls With Particular Reference To Hydraulic Jacks
Royal Aircraft Establishment, Report No. Mech. Engg. 12, Sept. 1949

The phenomenon of "judder" in jacks, when the piston rod moves in a series of increments has been analyzed by considering the jack as an elastic medium. Rubber seals provide friction, the friction under boundary conditions may well be 10 or more times greater than under film conditions.

H-063

Holt, J. B. and Miller, W. S.
Dynamic Seals And Packings
Machine Design, V. 29, pp. 69-98, Oct. 31, 1957

Fluid tightness and service life - the principal measures of seal performance - meet design objectives when seal limitations are accurately matched to service demands. Prediction, not measurement, however, represents the first order concern of the designer. Basic to prediction of seal performance is study of these service conditions.
Pressure, Speed, Temperature, Fluid characteristics.
This article shows how these factors are analyzed to provide guides to selection and application of dynamic sealing methods.

H-064

Horning, D. O.
Vacuum Vessel Construction Techniques And Sealing Methods
Inst. Eng. Res. Univ., Calif. Tech. Rept. No. HE-150-84, 15-5-51

The factors which govern the design of large-size vacuum plant are discussed. (Wind tunnel) (external press. 14.7 lbs. psi - vac 1×10^{-6} mm Hg) Leak detection methods discussed. Permanent and mechanical joints are discussed.
Mechanical seals with gaskets, and O-ring seal teflon material.
Design calculation included.

H-065

Hornschuck, H.
Packing Problems On High-Pressure High-Temperature Pumps
Power, V. 87, pp. 225-226, 280, 281a, April, 1943

Pressures and temperatures involved in centrifugal pump stuffing boxes have surpassed tolerance of packing materials. Control obtained by throttling and external cooling both unsatisfactory expedients. Mechanical sealing devices being considered.

H-066

Hornschuck, H.
Why Mechanical Seals Improve Centrifugal Pump Operation
Power, V. 87, pp. 524-526, Aug. 1943

Lists how's and why's of putting stuffing box seals to good use on centrifugal pumps and lists the conditions that must be satisfied for successful operation.
Such information as seal construction balanced vs. unbalanced seals, lubrication, leakage, etc. are discussed.

H-067 T

Horsley, W. D.
Hydrogen Cooled Alternators
The Engineer, V. 186, pp. 587-589, Dec. 10, 1948

A buffered seal integral with bearing, a floating bushing liquid buffered seal, and a combination labyrinth and liquid buffered mechanical face seal, have been used with some success. The quantity of hydrogen makeup is not proportional to the leakage unless the leakage is excessive.

H-068

Hosang, E. (In German)
Recent Developments In Field Of Elastic Gaskets For Moving And Detachable Machine Parts
Werkstoffe u Korrosion, V. 2, pp. 191-4, May, 1951

Mechanical, thermal, electrical and chemical behavior; gaskets and stuffing boxes of synthetic rubber such as perbunan, silicones, thiokol and polyethylenes; suggestions and examples for design and installation of mechanically and chemically stressed packings and stuffing boxes.

H-069 B

Hough, A. T.
The Resistance Of Leathers To Hot Oil, And The Preparation Of Leather Suitable For Oil Seals
J. Society Leather Trades Chemist, V. 34, 4, pp. 138-49, April, 1950

H-070

Houghton, E. F.
Design And Application Of Leather "U" Packings
Modern Ind. "Press," V. 7, pp. 22, 24, 32, May, 1945

Original "U" packings had rounded corners. Improved reliable design packing with square bottom made possible with advent of more flexible mineral tanned leathers. Packing used most commonly in conventional gland, described in article "U" packing "Don'ts" listed.

H-071

House, P. A.
Self-sealing of Aerospace Ships By The Double Hollow Wall Concept
Aeronautical Systems Div., Wright-Patterson AFB, Technical Doc. Rept. No. ASD-TDR-62-248, Feb. 1962, 14 p.

To protect aerospace ships from loss of air when their walls are punctured by foreign objects such as micrometeoroids, a self-sealing wall structure was devised. The wall structure consists of an outer layer of aluminum sheet, a sheet of 3000 psi buna-N, a layer of fluid, another sheet of buna-N, a layer of a second fluid, and another sheet of buna-N comprising the inner wall. When the system is punctured, the two fluids mix, immediately solidify, and seal the puncture. Holes up to 0.075 inch in diameter can be sealed in this manner.

H-072

Housley, J. E.
Aluminum As A Gasket Material
Power, V. 65, p. 374, March 8, 1926

A description of events leading to the replacing of composition and lead gaskets with 2SO aluminum used (commercially pure and annealed dead soft).

H-073
Howard, J. H.
Designing With Metal Bellows
Machine Design, V. 26, pp. 137-48, Jan., 1954

A complete reference on the design of metal bellows, with tables on materials hysteresis, coefficients of thermal expansion and drawings showing various applications.

H-074
Howe, P. G.
Greaseless Vacuum Rotor Seal
Rev. Sci. Instr., V. 26, p. 625, 1955

Teflon ring gaskets which fit between the joints of a standard ground-glass joint or a hollow barreled vacuum stopcock and which are made vacuum-tight by Hg seal have been used in the construction of a vacuum rotor seal capable of holding a vacuum, while pumping, of about 10^{-5} MM Hg.

H-075 B
Hudson, R.A.
Some Recent Developments In Truck Wheel Seals
S.A.E. Paper 119, V. 3, p. 7, fig., October, 1959

A recent advance in lip seal design is described and should be attractive to all users insofar as they will no longer have to ensure that the shaft finish is up to any special standard. It would seem that the design will also have applications as a corrosive fluid seal since the metal sleeve can be made from a high corrosive resistant material.

H-076 T
Hughes, D. P.
Shaft Seal For High Gas Pressures
Int. Conf. on Fluid Sealing, Paper C1, 14 pages, British Hydromechanics Research Association, Harlow, Essex, England

A discussion of the design and development of a visco seal for a shaft which penetrated a nuclear reactor containment vessel wall.
Shaft 4.725" turning at 1500 rpm sealing against gas pressure 150 psi. Development work was done on a 1.5748" shaft turning at speeds up to 5000 rpm.
Complete description of test facility, experimental results, and final design configuration is presented.

H-077 T
Huhn, D.
Theory Of Fluid Sealing
Int. Conf. On Fluid Sealing, Paper D2, (8 pgs.), April 17-19, 1961

Basic laws for leakage, wear, and power requirements are deduced from the general equation for fluid motion, for radially and axially contacting seals. Pressure forces, and their influence, as well as improvement by hydraulic balance are discussed. Shaft eccentricity, vibrations, surface conditions to power consumption, and heat development by rotating seal parts were not considered.

H-078
Hull, J. W. (Boeing Aircraft)
The Development of Metal Piston Rod Seals For High Temperature Hydraulic Actuators
S.A.E., Technical Committee A-6 Meeting, May, 1958

H-079
Hull, J. W.
Ring-Spring Design For High Performance Metal Static Seals
Hydraulics & Pneumatics, V. 13, pp. 122-126, Sept., 1960

Eliminates necessity for a precise degree of axial compression for effective sealing that is a defect in face sealing metal seals. Ring-spring static seals give excellent results from -65 to 700°F, with cycling pressures of 0 to 4000 psi, and surges to 6000 psi. Operation and design are fully explained. Seals developed for aircraft hydraulic systems.

H-080 B
Hummer, H.
Material Selection For Mechanical Seals
American Society of Lubrication Engineers, Paper 58AM-A3, 5 pp., April, 1958

This paper presents the opinions of the Director of the Dura-Metallic Corp. on the most suitable face materials for mechanical seals. Fluids covered are water (hot and cold), petrol and other hydrocarbons, oil and oil solutions and acids. The merits and drawbacks of such materials as stellite, ceramics, and glass filled P.T.E.E. are discussed.

H-081
Hutchison, R. O.
Seal And Gasket Materials For Liquid Nitrogen
Carbide and Carbon Chemical Corp., Y-12 Plant Report Y-268, Sept. 22, 1948, 11 pp

Tests were conducted to determine the most suitable materials for a vacuum tight gasket and seal on equipment coming in contact with liquid nitrogen. Aluminum, copper and lead were used as metal gaskets. Duxseal, lubriseal, glyptal, bouncing putty, silicone rubber, fluorinated hydrocarbons and silicone high vacuum grease were used as seals. A lead gasket with silicone high vacuum grease gave superior results and is recommended for the application described herein.

H-082
Hyde, G. F., Fuchsluger, J. H.
Materials For Elevated Temperature Piston Ring And Seal Ring Applications
Lubrication Engrg., V. 17, pp. 476-483, Oct., 1961

Explanation of basic functions of piston rings and seals and summary of properties required of materials for such parts necessitated by increasing temperatures and reduced lubrication.
Materials tested divided into following categories; carbons, carbides, nitrides, borides, and intermettalics, ceramics and cements, irons and steels, high temp. alloys, hard facing alloys, surface treatment and coatings.
Best materials standpoint of wear and oxidation resistance were found to be impregnated carbons, metallic carbides, and intermetallics, most of which unfortunately present problems of design and fabrication. Temperature range 600 to 1200°F. Rubbing speed 1,600 sfpm.

H-083
Hyler, J. E.
Practical Points On Packing
Mill & Factory, V. 48, pp. 102-106, March, 1951

Gives fundamental "whats-and-whys" of packing construction and performance with particular emphasis on requirements in the hydraulic and pneumatic fields.
Some packing materials mentioned are leather O-rings, asbestos fabric, asbestos yarn. The last mentioned material is often employed in connection with soft-metal foil, which is wrapped around it, generally by helical wrapping. Such a wrapping is suitable for steam applications to 550°F. Copper-foil covered packings having a core of dry asbestos may be used against steam up to 1000°F.

H-084
Hyler, J. E.
Oil Seals On Modern Machinery
Canadian Machinery and Manufacturing News, V. 65, pp. 112-3, 140, 142, Aug., 1954. Sept. pp. 144, 146, 148, 152

Oil seals applied to rotary shafts on different types of machinery; factors important in design of seals; use of standard or stock oil seals recommended because of their lower cost. Application of single spring loaded seals employed in Gemmer hydraulic steering gear, rotary gear pumps, chain saw, in diesel engine governors, etc; manufacture and advantages of axial and radial seals.

I-001
Inall, E.K.
Shaft Seal For Pumps Handling Low Temperature Sodium-Potassium Alloy
Rev. Sci. Inst., V. 32, 1153-4, Oct. 1961

Details of the seal mounted in the housing, which can be filled with oil to a suitable level visible in the filler. Lubricates the lip seal and cools it by circulation induced by the spinning shaft.

I-002
Ingham, E.
Pump Packing
Colliery Guardian, V. 170, pp. 35-37, July 13, 1945

Suggestions as to selection, care, application, and periodical inspection of pump packings.

I-003 B
Iny, E.H., Cameron, A.
Rotary Oil Seals
British Hydromechanics Research Association, RR 579, 11 pp., 21 fig., February 1958

A large amount of experimental data obtained from the lip seal apparatus made by B.H.R.A. is presented and the author attempts to correlate this to current theories.

I-004 T
Iny, E.H., Cameron, A.
Synthetic Rubber Rotary Shaft Seals - The Fluctuation Of The Interfacial Gap At Moderate Shaft Speeds
British Hydromechanics Research Association, RR 683, Jan. 1961

I-005 T
Iny, E.H., Cameron, A.
The Load Carrying Capacity Of Rotary Shaft Seals
Int. Conf. on Fluid Sealing, Paper A2, (14 pages) April 17-19, 1961, British Hydromechanics Research Assn., Harlow, Essex, England

The effect of vibration on performance of a synthetic rubber rotary shaft seal is investigated. Under normal working conditions the interfacial gap fluctuates at twice the shaft speed, this mode of oscillation permits the generation of oil film between the faces which is capable of carrying considerable loads.

I-006 T
Isenbarger, R.O.
Theory And Practice In Design Of Hydraulic Seals
Applied Hydraulics, V. 3, pp. 14-16, 20, 40, Feb. 1950, pp. 22-24, March 1950; pp. 24-26, May 1950

Definitions, effects of operating conditions, properties of sealing materials, and desirable characteristics for various sealing conditions.
Radial and axial mechanical dynamic seals are described in May issue.

I-007
Isenbarger, R.O.
Surface Type Seal
Proc. of Eighth National Conference on Industrial Hydraulics, V. 6, pp. 220-228, Sept. 1952

Description and operation of the various types of flat-surfaced axial shaft seals.

I-008
Isenbarger, R.O.
How To Prevent Oil Seal Failures
Product Engng., V. 24, pp. 154-159, Jan. 1953

Reasons for shaft seal failure listed together with remedies for failure. Check list supplied as guide for proper seal selection.

I-009 B
Isenbarger, R.O.
Sealing Devices For The Exclusion Of Foreign Material From Hydraulic Mechanisms
Proc. National Conference Industrial Hydraulics, V. 14, pp. 207-19, disc. pp. 219-22, Oct. 1960 (Abstracted from Hydraulics and Pneumatics, Oct. 1960)

Special consideration to exclusion sealing operational conditions, motion, material to be excluded. Axial and radial exclusion seals for rotating shafts. Wipers, scrapers, boots and diaphragms for reciprocating shaft.

I-010 T
Ishiwata, H., Herabayashi, H.
Friction And Sealing Characteristics Of Mechanical Seals
Int. Conf. on Fluid Sealing, Paper D5, 22 pp., April 17-19, 1961, British Hydromechanics Assn., Harlow, Essex, England

Large number of radial face seal test in which the seal is considered to be analogous to a thrust bearing. It is shown that the coefficient of friction of a seal pair varies from 0.01 to 2.0, and suggests that this variation may correspond to the various regions of hydrodynamic lubrication. Experimental data correlation with nondimensional groups.

I-011
Islinger, J.S.
Development Of High-Low Temperature Aircraft Canopy Seals, Part 5: New Material Seals Of Current Design
P.B. 128235, Off. Tech. Serv., June 1956, 57 pp., also Contract AF-33(600) - 27588, ARF Proj. MO58, AF WADC TN 54441, Part I

Silicone rubber seals were evaluated in Part I of a program to develop high-low temperature cabin pressurization and rain seals to be used with present and future aircraft canopies. Three representative seal designs were evaluated. The seals fabricated from recently developed silicone elastomers, were to be capable of functional operation at extreme temperatures of -85°F and +200°F. The evaluation tests were conducted with each seal installed in a test fixture simulating a "half size" aircraft canopy.

I-012
Iwanami, S. Kato, H., and others
Oil Leakage From O-Ring Packing
JSME Bull., V. 2, pp. 638-643, Nov. 1959

Experiments were conducted to find out the behavior of oil leakage from an O-ring packing used for gaskets and reciprocating parts.
Conclusions:
1. For gasket: Seals can be made leakproof for oil pressure up to 280 Kg/cm^2, 4000 psi limit of this test pressure.
2. For reciprocating use: Quantity of oil leakage is proportional to the square of the reciprocating velocity of the rod, the n-th power of the kinematic viscosity of the oil.

I-013 T

Iwanami, S., Tikamori, N.
Oil Leakage From An O-Ring Packing
Int. Conf. on Fluid Sealing, Paper B2, 10 pp., April 17-19, 1961, British Hydromechanics Research Assn., Harlow, Essex, England

Report on experiments conducted to determine leakage characteristics of O-ring packings used for reciprocating shafts. Conclusions of experimental results.
1. The compressive force for squeeze is proportional to 1.2 power of the cross-sectional diameter of the O-ring, 1.3 power of the squeeze and 4.5 power of JIS hardness of the rubber.
2. Reciprocating use; the quantity of oil leakage is proportional to the square of reciprocating velocity of the rod and n-th power of fluid viscosity.
(N = 1.5)

J-001
Jackson, H.D.
Common Sense About Packings
Nat. Eng., V. 51, pp. 252-6, April 1947

Some reasons why packings fail; factors which affect packing service; problems encountered in centrifugal pumps; burnishing plungers to eliminate troubles; proper proportions of rods and stuffing boxes; shaft clearances and lanterns; stuffing boxes and packings for stop valves; packing failures from operating errors.

J-002
Jacobs, E.
How They're Sealing Cylinders
Hydraulics & Pneumatics, V. 15, pp. 67-76, 78, August 1962

Two static seals: the end seal and the piston-to-rod seal assembly. Two dynamic seals: the piston seal assembly and the rod bearing seal assembly. Covers lip seals, V-ring seals, cup seals, U-ring seals, flange seals, squeeze-type molded seals such as D, delta, T, square, X, and O-rings, rider or wear rings, back-up rings, and piston rings.
Materials are metals, polymers, plastics, leather and fabric-reinforced rubber.
Discusses a temperature range from -450F to 1500F.
For high pressures, ring-type seals and proper assembly are important.

J-003 T
Jacobson, M.J., Charnes, A., Saibel, E.
Studies In Lubrication: The Complete Journal Bearing With Circumferential Oil Inlet
Trans. Amer. Soc. Mech. Engrs., V. 77, pp. 1179-1183, 1955

An approximate pressure solution is developed for the Reynolds' equation for the case of the end-lubricated complete journal bearing.
Expressions are obtained for the load-carrying capacity, coefficient of friction, axial thrust, and lubrication rate flow. Applicable to the buffered bushing seal.

J-004
Jacquet, A.E.
Metal Gasket For Cylindrical Elements In Motion
LC or Spec. Lib. Assoc. Trans. #59-12919

A gasket is described which prevents passage of fluid between two cylindrical elements in reciprocal motion. The gasket is composed of a bell mounted metal sleeve, cut with a groove concentric to the axis and having a straight flank and an oblique flank. The sleeve is combined with an expansion ring of a metal harder than that of the sleeve, fitting the profile of the groove and tending to press the thinned lip of the groove against the element in motion.

J-005
Jaeckel, R., and Kammerer, E.
Suitability Of Buna Rubber For High Vacuum Packing (In German)
Zeit fuer Technische Physik, V. 23, pp. 85-8, 1942

Results of investigation demonstrate that buna rubber products can be produced which have no greater gas emission than natural rubber in high vacuum.

J-006
Jagger, E.T.
Rotary Shaft Seals
Scientific Lubrication, V. 9, pp. 24-27, April 1957

Mechanism of sealing is that the surface tension of the oil forms a meniscus which prevents oil flow through the gap between the seal and the shaft.

J-007
Jagger, E.T.
Study Of The Lubrication Of Synthetic Rubber Rotary Shaft Seals
IME Proc. of Conf. on Lubr. & Wear, pp. 409-415, Oct. 1, 1957

Subject of the paper is the investigation into the nature of the oil film which is present between the sealing lip of a conventional synthetic rubber oil seal and the shaft on which it operates.
Conclusion: Oil seals of the type under discussion have the sealing point separated from the shaft by a coherent film of oil with a thickness of 10^{-4} in.

J-008
Jagger, E.T.
Rotary Shaft Seals: The Sealing Mechanism Of Synthetic Rubber Seals Running At Atmospheric Pressure
I.M.E. Proc., V. 171, pp. 597-616, 1957

Very little was understood about the sealing mechanism. Article describes equipment and tests which were run to throw light on this subject. It was concluded that when the seal is functioning normally there is a coherent film of oil between the sealing lip and the rotating shaft. The mechanism of sealing is that the surface tension of the oil forms a meniscus which prevents oil flow through the gap between the seal and shaft.

J-009 B
Jagger, E.T.
The Sealing Of Anti-Friction Bearings
Sci. Lub., V. 10 (Special Extra Issue), pp. 39-40, 42, 44-47, Nov. 1958

This article describes many of the different ways in which lip seals may be used to reduce leakage from bearings. Several diagrams illustrate the various arrangements and the effects of working conditions. Other factors on seal life are considered.

J-010 B
Jagger, E.T.
Effect Of Cylinder Surface Finish On The Performance Of Hydraulic Packing
Proc. 2nd European Fl. Power Conf., pp. 53-62, April 1960

Comprehensive study of the relation of cylinder surface and hydraulic packing for 500 different packings and 76 different tubes.

J-011 T
Jagger, E.T.
Rotary Shaft Seals - Some Effect Of Shaft Surface Finish
Int. Conf. on Fluid Sealing, Paper A1, 14 pp., April 17-19, 1961, British Hydromechanics Research Assn., Harlow, Essex, England

Results of experimental work on the effect of shaft surface finish on performance of lip seals.
Surface finish measurement. Wear of shaft and seal, extended running test.
Influence of dirt and grit. Effect of hardness of shaft, and initial shaft surface finish.

J-012
Jenner, A.W.
Metallic Gland Packing For High Pressure
Mech. World, V. 97, pp. 327-8, April 5, 1935

Principles and application of successful metallic packings.

J-013
Jerie, J.
Flow Through Straight-Through Labyrinth Seals
7th Int. Cong. Appl. Mechanics Proc., V. 2, pp. 70-82, 1948

Improved efficiency of steam or gas turbine and axial compressor blading, compressor impellers, etc. together with increasing pressure ratios enhance the importance of leakage losses through labyrinth seals. Better knowledge of flow through these seals is desirable. This covers such a study.

J-014
Johnson, A.E.
Pipe Flanges Research Committee, Third Report
Proc. Instn. Mech. Engng., London, V. 168, pp. 423-64, 1954

The third report is concerned with the results of a program of investigation into the elastic and plastic behavior of flanges, drilled and undrilled, by means of model flanges and certain bolt material.
An addendum to the report refers to matters which arise in connection with utilization of its results for engineering needs.
Test description, data, results, curves and photos presented.

J-015
Johnson, C., Butzin, P.E.
Air Powered Hydraulics
Proceedings of National Conference on Industrial Hydraulics, V. 6, pp. 111-20, 1952

Comment on special application of O-rings in pairs, contrary to usual procedure, and "matching" them with oil used.

J-016
Johnson, C.
Dynamic Sealing With O-Rings
Mach. Design, V. 27, pp. 183-188, Aug. 1955

As static seals, O-rings have been almost universally successful. This is not true of dynamic applications. Most unsatisfactory installations can be traced to misapplication, improper design and maintenance. Such problems are discussed together with O-ring idiosyncrasies.

J-017
Johnson, D.P., Bowman, H.A., and others
A Versatile Closure For High Pressure Vessels Utilizing O-Rings For The Initial Seal
I.S.A. Journal, V. 3, pp. 241-242, July 1956

A method of simplifying fabrication and assembly of Bridgman unsupported area closures by use of commercially available rubber O-rings. (150,000 psi and above) Drawings.

J-018
Johnson, H.
Packing Kinks
Power Plant Engineering, V. 25, pp. 925-6, Sept. 15, 1921

RR-1923 - Vol. 27
1929 - Vol. 33

J-019
Johnson, M.E.
Stuffing Box And Expansion Joint
U.S. Patent 2,528,436, Oct. 31, 1950, to U.S. Atomic Energy Commission

This patent discloses a stuffing box and expansion joint assembly for a retort containing a rotating shaft arranged so as to permit longitudinal expansion and misalignment of the retort without interfering with the rotation of the shaft or disturbing the gas-tightness of the stuffing box.

J-020
Johnson, R.L., and others
Wear Of Materials For High Temperature Dynamic Seals
SAE Paper, No. 686, p. 7, Jan 9-13, 1956; also NACA - Tech. Note 3595, p. 22, Feb. 1956

Wear experiments with carbon seal materials sliding against various metals gave following results: wear was accelerated rapidly by operating at higher temperature levels; adverse effect of temperature on wear of carbon was minimized by use of chromium plate as mating surface. Application in aircraft gas turbine engines.

J-021
Johnston, W.L.
Home-Made Metal Packing Gives Four Years' Service
Power, V. 68, pp. 26-7, July 3, 1928

Split babbitt rings, each pair making a ring of square cross-section were used as packing. Description of assembly and operation. Drawings included.

J-022
Johnstone, Taylor, F.
New Metallic Gland Packing Gives Service
Power Plant Engineering, V. 30, p. 225, Feb. 1, 1926

Simple metallic packing specially suited for the rods of high speed steam engines.
At the base of the gland is a gun metal ring, followed by a ring of packing, a cast iron lantern bushing, two more rings of packing, a ring of soft asbestos, finally followed by the gun metal gland.
A second type considered is a spring loaded seal. Drawings and description.

J-023
Jones, D.H.
Design And Application Of Controlled-Volume Pumps For High Pressure In The Range Of 10,000 to 30,000 PSI
A.S.M.E. Trans., V. 75, pp. 361-67, 1953

Seal abstract: Sealing of a reciprocating plunger. The most successful plunger-stuffing-box combination found thus far, Fig. 8, includes the use of a hardened plunger superfinished to 3 to 5 micro inches, with a special arrangement consisting of a soft metallic packing combined with other packing materials. Such a combination has proved satisfactory up to 30,000 psi. Drawings included.

J-024 T
Jones, W.E.
Sealing With Present Day Methods
Design Engineering, V. 4, pp. 41-44, March 1958

A brief discussion is presented on static, rotary, and reciprocating seals.

J-025
Jordan, J.
Extreme Temperature Sealing
Missile Design and Development, pp. 24-26, Jan. 1959

New method uses O-ring and retainers of dissimilar metals.

J-026
Jordan, J.
Thermal Expansion Of Elastomers
Mach. Design, V. 32, p. 144, Jan. 7, 1960

New design for improved seals of synthetic rubber.

J-027
Jordan, J., and McCuistion, T. J.
The In-Place Seal
Product Engineering, V. 31, pp. 68-72, April 18, 1960

In-place seals are static seals in which rubber or an elastomeric compound is molded directly in a groove of the metal seal part. Thus it fits the groove better and responds better than O-rings to the various pressures. A comparison of gaskets, O-rings, and in-place seals is given. Figures are given for resistance of elastomers to fluids, thermal expansion, and life expectancy as affected by operating temperature.

J-028
Jordan, J.R.
Sealing Problems
Oil and Gas Equip. Reprint, Dec. 1959

O-rings; their use in solving important sealing problems.

J-029
Jordan, J.R.
Select O-Ring Replacements With Properties In Mind
Plant Engineering, V. 15, pp. 112-114, Jan. 1961

J-030
Jordan, J.R.
Seals For Hard Vacuums
Machine Design, V. 33, pp. 134-139, May 25, 1961

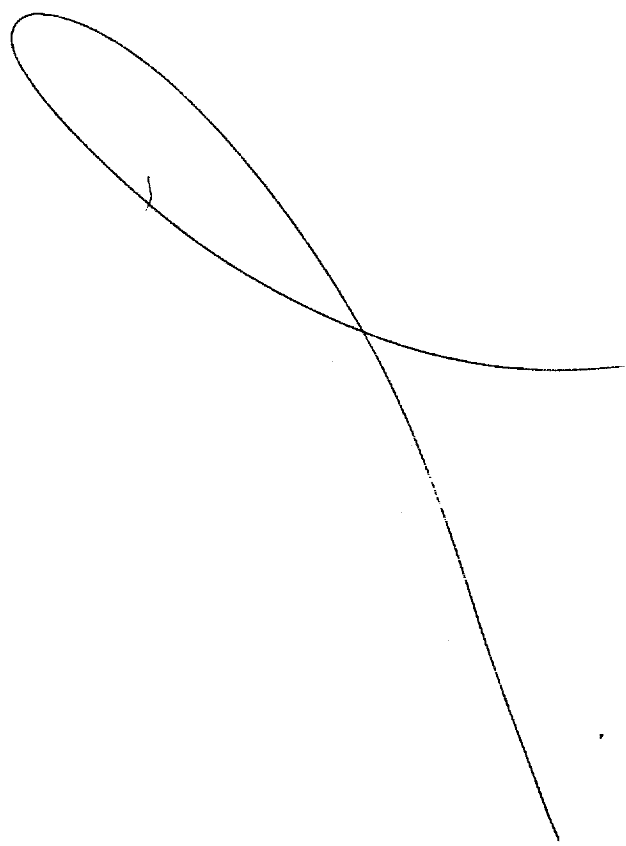
A study of seal materials for pressures below 1×10^{-6} mm Hg. Materials must have low permeability for low molecular leakage. They must not volatilize and sublimize in hard-vacuum environments. The properties of butyl and viton synthetic rubbers seem most suitable for these applications.

J-031
Jordan, J.R.
New Developments In Vacuum Sealing
Am. Vac. Soc. 1961 Trans., Eighth Nat. Vac. Symposium, Second International Congress, V. 2, pp. 1302-1308

New data concerning efficacy of elastomeric seals in vacuum are presented. Leak rate data and sublimation effects are used to assess the utility of these seals in "ultra high" vacuum systems and in space. Leak rates at several temperatures, permeability, sublimation effects, outgassing, and accessibility are discussed.
Silicones, Polyurethane, Vitons, Nitriles, Chloroprene, and Butyl compounds are used. Data tables.

J-032
Justice, R.W., and Plumley, E.
Leather Packings For Hydraulic Roll Jacks
Iron & Steel Engr., V. 23, pp. 82-4, Sept. 1946, pp. 103-5, Dec. 1946

The change to leather V. packings and improvements obtained; advantages of V. leather assemblies; leather versus composition packings.



K-001
Kalk, W. A.
Design Criterion Of Plenum To Reflector Block Seal For H.T.G.R. Reactor Vessel
(General Atomic Div., General Dynamics Corp., San Diego, California) (GAMD 1375)
Nuclear Science Abstract #17294-Contract AT(04-3) 314 (16 p.), April 20, 1960

A survey was made of sealing methods and their adaptability to the requirements of the plenum reflector seal on the HTGR reactor vessel. Lap joints of steel to graphite or graphite to graphite with a 100 RMS surface finish met the required leak rate (43.8 pounds/hr. helium) and two basic concepts of this type seal are illustrated.

K-002
Kalmus, P.I.P.
A Simple Flexible Vacuum Joint
Vacuum, V. 9, No. 2, p. 147, May, 1959

The new type of vacuum joint appears to have several advantages over the bellows coupling, the principal asset being ease of construction. The joint consists simply of a separate flange of special shape and a cylindrical tube. The vacuum seal between these is accomplished by means of a soft rubber O-ring which also gives the coupling its flexilibity. The O-ring fits around a polished section of the tube and is kept under compression in a groove which has an outside diameter 0.012 in. smaller than the outside diameter of the ring. The width of the groove is 0.005 in. less than the thickness of the ring, and its depth is sufficient to prevent the ring being pushed inwards along the tube by external atmospheric pressure.

K-003
Karassik, I.J.
Know Your B.F. Pump Stuffing Boxes
Power Engineering, V. 60, pp. 70-72, May, 1956

The operation of boiler feed pump stuffing boxes becomes more complex as pressures and temperatures go up.
Pressures of 400 psi and temperatures of 400°F are found.
Basic concepts are discussed.

K-004
Karassik, I. J., Carter, R.
Centrifugal Pumps: Mechanical Stuffing Box Seals
Industry and Power, V. 64, pp. 94-95, June, 1953

Presents mechanics of the seals. Diagrams.

K-005
Karassik, I. J., Carter, R.
Mechanical Seals For Centrifugal Pumps
Heating and Ventilating, V. 51, pp. 92-94, Dec., 1954

Packing types and gland inserts. Photographs, diagram.

K-006
Kavanagh, W.
Fitting The High-pressure Cylinder Of An American Ball Engine With A Special Metallic Packing
Power, No. 81460C, Jan., 1907

Illustrates and describes a difficult application of metallic packing.

K-007 T
Kaye, J., E. C. Elgar
Modes Of Adiabatic And Diabatic Fluid Flow In An Annulus With An Inner Rotating Cylinder
Trans. Am. Soc. Mech. Engr., V. 80, pp. 753-765, 1958

First phase of investigation of heat transfer in the air gap of a rotating electrical machine.
A review of laminar flow, laminate flow plus vortices, turbulent flow plus vortices, and turbulent flow.
Experimental results in graphical form. Preliminary heat transfer data.
Discussion.

K-008
Kearton, W. J.
The Flow Of Air Through Radial Labyrinth Glands
I.M.E. Proc., V. 169, pp. 539-550, 1955

Theory has been worked out for inward and outward flow with pressure distribution expressions being derived.
Single ring and multi-ring glands were investigated as were unstaggered radial glands.

K-009
Kearton, W. J. and Keh, T. H.
Leakage Of Air Through Labyrinth Glands Of A Staggered Type
IME Proc., V. 166, pp. 180-188, 1952

Theory presented for flow of air through single orifice. Extended to cover labyrinth gland of several constrictions of equal area. Experiments made over wide range of pressure ratios to determine coefficient of discharge for single annular construction having a small clearance.

K-010
Kegley, T. M. Jr.
Examination of HRT O-Ring Gaskets From Flanges A-117 And D-127.
Oak Ridge National Lab. Y-12, Tenn.
Metallography Report No. 40, Contract W-7405-Eng-26, Jan. 14, 1957, CR-57-1-50

The results of an examination of O-ring gaskets removed from the HRT following a discovery that water in the leak detector system contained 1000 PPM chloride are presented.

K-011 T
Keller, C.
Flow Tests On Labyrinth Glands For Steam Turbines
Escher Wyss News, V. 7, No. 1, pp.9-13, Jan./Feb., 1934, also Power Plant Engineering, V. 41, No.4, pp. 243-245, April, 1937

Development test made by Escher-Wyss Company on steam turbine labyrinth glands. Flow patterns were photographed using light metal particles which reflected light through glass observation panels.

K-012
Keller, G. R.
High Temperature Hydraulics
Mach. Design, V. 28, No. 16, pp. 121-24, August 19, 1956

Considerations when designing for high temperature hydraulics. Fluids, synthetics, compounded diesters, silicone fluids, Buna S base O-rings, neoprene seals, compression set, back-up rings, springs, structural metals, filtration. Discussion - no test data.

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K-013
Keller, G. R.
Optimizing Hydraulics For High Temperature Operation
Western Aviation, V. 37, p. 913, December, 1957

Discussion of the optimization of hydraulic systems to fit the increasingly high temperature conditions under which aircraft and missiles are being operated.

K-014 B
Keller, G. R.
Design Of Seals And Sealing Devices
Chapter 12 of book, "Aircraft Hydraulic Design," Publ. by Appl. Hyd., 1957

K-015
Keller, G. R.
Overcoming Some Of The New Problems In Hydraulic Control
Automatic Control, V. 7, pp. 38-41, July, 1957

Areas which will require special attention by the systems designer are outlined in this article. Temperatures, dynamics of hydraulic system, fluids, radiation, and some of the new seals available are discussed.

K-016 B
Keller, G. R., Mayhew, W. E., Cannon, C. H.
High Temperature Hydraulic And Pneumatic Equipment
I. Future Aircraft Power Systems, Gas Or Liquid
II. Hot Hydraulic Systems
III. Hot Pneumatic Systems
Control Engineering, V. 6, No. 4, pp. 89-104, April, 1959

I. Bases for choice, viscosity factor, materials and components
II. Fluids, components, servovalves, seals, summary
III. High temperature design problems, fillings, and seals, actuator, valves, spool valves, safety

Recommendations

K-017
Keller, G. R. and Stafford, P. H.
Metal Dynamic Hydraulic Seals
SAE Jour., V. 65, No. 6, p. 76, May, 1957

Testing and evaluation program undertaken at Autometics, Div. of North American Aviation, Inc. to study performance of metal dynamic seals for use in missiles or aircraft hydraulic equipment in lieu of elastomer seals, which are unsatisfactory at high speeds, high temperature; tests at room temperature of seals of various configurations, material finishes, etc. Shaft and piston seals tested at oil temperatures from 500-550°F and diameters ranging from 1/2 to 3-3/8 inches.

K-018
Kelley, S. G.
Gasket Materials; Their Properties And Uses
Materials & Methods, V 36, pp. 108-112, Aug., 1952

Available to meet the many different service conditions under which gasketed joints must function are a wide assortment of synthetic and natural materials. Among these are rubber, both natural and synthetic, cork, plant fibers, asbestos fibers, metals, plastic, leather, and felt. Properties of each are discussed.

K-019
Kenyon, R. L.
Pressure - Energized Seals
Rocketdyne, Division of N.A.A., July, 1960

Problems associated with static seals, and seal configuration.

K-020
Kephart, R. C.
High Pressure Steam Joints And Gaskets
Am. Soc. Nav. Engrs. Jour., V. 46, pp. 100-106, Feb., 1934

K-021
Kerkhof, W. P.
New Stress Calculations And Temperature Curves For Integral Flanges
Proc. 3rd World Petroleum Congress, 1951

K-022
Kiergan, N. B.
Aircraft Hydraulic Systems
P.B. 16819 - Off. Tech. Ser. (2 pp.), Oct., 1945 (Japanese) (AAF Am. Tech. Intelligence Group Report 18)

Interrogation of Takeo Dor, Chief Engineer of Kawasaki Aircraft Co. covered the problems of leakages and packing problems, power source, standard mineral fluids and equipments with which hydraulics were operated. Soy bean oil or rapeseed oil added to hydraulic control oil reduced the swelling rate of rubber parts to one half. Silk packings soaked in polyvinyl alcohol and metapscryl resin had good quality.

K-023
King, P.
Maintenance Of Metallic Packing On Locomotives
Am. Engr. & RR Jour., pp. 178-179, V. 78, May, 1904

Discusses the treatment packings should receive.

K-024
King, L.D.P.
High Vacuum Seal
Re. Ser. Inst., pp. 83-84, Feb., 1948

A sample two way valve and method of making a seal are described, both well adapted to large or small port openings in high vacuum work.

K-025
Kitts, F.G.
Development Of A Rubber For Service In Contact With Experimental Hydraulic Fluids At 400°F
PB 111598, Off. Tech. Sev. (15 pp.), Dec. 1954, CAA

A compound of neoprene WRT was developed which was marginally satisfactory after aging 168 hours in MLO-8200 at 400°F in absence of air. If air were not at least partially included the rubber would reach unsatisfactory conditions in less than 70 hours. O-rings have been fabricated and are undergoing evaluation tests. (AAF WADC-54-458)

K-026

Klein, Wilhelm
Centrifugal Pump With A Stuffing Box Relieved From Pressure
L. C. or S.L.A. Trans. 59-12619

K-027 T

Kluge, F. H.
Rotating Shaft Seal Means
U.S. Patent 2,621,087, Dec. 9, 1952

Relates to a buffered shaft seal using carbon rings. A slinger ring throws liquid away from the shaft near the housing and is backed up by three sets of carbon seal rings. Between the first and second set, a neutral gas is introduced at a pressure greater than the sealed pressure causing flow inward and outward. Between the second and third rings an outlet is provided for that portion of the neutral gas which flowed outward. This outlet may be kept at a pressure lower than atmospheric to prevent escape of the neutral gas to the atmosphere.

K-028 T

Klupgrl, A.
Contactless Oil Film Shaft Seal For Hydrogen-Cooled Generators (in German)
German Patent 1,012,999, August 1, 1957

A bushing seal made of two axially contacting rings with a central supply groove for the buffer fluid. Clearance on process side of ring is made smaller than atmospheric side, thus reducing the flow of oil toward the process side. The seal ring incorporates discontinuous grooves which may be situated at an angle.

K-029 B

Knight, E.J.
Pneumatic Motors For Aircraft Actuation Systems
Aero/Space Engineering, V. 17, No. 12, pp. 44-7, Dec. 1958

Discusses the construction and performance of various pneumatic actuators. Special attention is given to materials and seals.

K-030

Knights, H. C.
Improvements In Or Relating To Sealing Devices For Tubular Members
British Patent 877,006

A sealing device is designed for effecting an endwise seal between two tubular members of different diameters.

K-031

Knudsen, A. W.
Metallic Vacuum Tight Gasket
Review of Scientific Instruments, V. 23, pp. 566-6, Oct., 1952

The unique properties of indium metal make it very well suited to the problem of a non-organic vacuum-tight gasket. Sheet stock 0.007 in. thick. Detail discussion of mounting procedure and recommendation.

K-032

Koch, H. G.
Engineering Studies In Packings
Paper Tr. J., V. 126, pp. 27-31, Jan. 1, 1948, Paper Ind., V. 29, p. 1494, Jan., 1948

K-033

Koch, R. H.
Packing And Gasket Materials
Machine Design, V. 28, pp. 117-120, May 31, 1956

Requirements for heat and cold resistance, chemical resistance, and life are tightening up a continuing search for more effective sealing materials. Recent attention has been focused on fluorocarbon plastics and new type elastomers which are discussed in this article.

K-034

Koch, R. H.
Improving Performance Of Packings And Gaskets
ASME Paper N57-PET-33, p. 15, Sept. 22-25, 1957

Practical aspects of maintenance problems and corrective actions that can be taken to minimize costs and unscheduled equipment shutdown; material, environment, and application which influence performance; how their effects are analyzed; particular reference to chemical and petroleum processing industry.

K-035

Koenig, T.H., Vargo, J. E.
Silicone Lubricant - Carbon Seal Interaction At Elevated Temperatures
WADD Tech. Report 60-757

Static immersion tests using 18 grades of carbon in combination with three silicone oils, one ester, and one silicone-ester blend at temperatures of 400°F, 500°F, and 550°F. A friction test rig has been constructed that can vary load, speed, and ambient temperature at the test section. Test run with QF6-7012 silicone oil at 3000 rpm, 45 psi face pressure, and ambient temperature.

K-036 B

Komotori, K.
Flow Observations In The Labyrinth Packing
Proc. Fujihara Memorial Fac. Engg. Keio Univ. (Japan) V. 9, No. 3, pp. 33-41, Oct. 1956 - in English

The flow patterns in the labyrinth packings were investigated, based on flow observations which were carried out by using a "smoke-tunnel." Moreover, these results are discussed in reference to my experimental data on the leakage loss through the labyrinth packing which was previously reported.

K-037

Kosting, P. R.
Neoprene Packings
P.B. 25428 Off. Tech. Sev. (6 pp.), Dec., 1941
(Watertown Arsenal Lab. Rept. 750/7)

Tests were made in order to determine the pressure which is exerted outwardly against the wall of a recoil cylinder when a backing ring made from neoprene is subjected to a given lateral pressure. The load, movement of the cylinder and diameter of the ring were observed. It was concluded that the same unit pressure is considered to be exerted outwardly against the cylinder wall as is applied laterly to packings of neoprene.
Diagrams.

K-038
Kotelewsky, G.P.
Gasket Reactions And Sealing Pressures In Vessels
Ind. Eng. Chem., V. 51, pp. 949-51, Aug. 1959

A method for calculating the maximum sealing pressure for gaskets in high-pressure vessels is developed by analyzing the forces among flanged connections, loaded bolts and gaskets.

K-039
Kraus, R.A.
Modern Sealing Devices For The Steel Industry
Iron & St. Engr., V. 26, pp. 53-64, Sept. 1949

Rotating shaft seals are discussed for a variety of application: pumps, gear reduction cases, machine tools, electric motors, etc.
Materials; flax, jute, cotton, rubber and several metallic materials.
Buna N is used for certain specialized applications.

K-040 B
Kronberger, H.
Vacuum Techniques In The Atomic Energy Industry
Proc. I. Mech. E., V. 172, pp. 113-24, disc., pp. 125-32, 1958, (abbreviated) Engineer, V. 204, 5312, pp. 702-5, Nov. 15, 1957

The development of atomic energy has stimulated a rapid development of industrial high-vacuum technology. Much attention to design details of welded and flanged joints. Joints and flanges - examples of good and bad of welding practice. Flanged joints for liquid metal, high pressure, high temperature.

K-041
Kruesi, A.H.
Fittings For Superheater Steam
West Electn., V. 41, p. 450, Dec. 7, 1907

The most satisfactory gaskets are of thin sheet steel not more than 5/8 in. in radial width, so that heavy pressure can be brought on it with bolts and flanges of ordinary weight, the steel being soft annealed so that it can be pressed into the rough surfaces of abutting flanges.

K-042
Krug, L.G.
Bearing Seals
Iron & St. Engr., V. 23, pp. 77-82, Nov. 1946

Steel mill bearings need complete protection against the entry of water and scale and loss of lubricant. This paper concerns these steel mill seals. 800 psi pressure and 240°F operating norms.

K-043
Kuchler, T.C.
Dynamic Sealing: Theory And Practice
Koppers Co., Inc., Baltimore, Md., Feb. 1961

K-044
Kuchler, T.C., and Pearson, W.
Clearance Seals
Machine Design, The Seals Book, pp. 20-23, Jan. 19, 1961

Clearance seals limit leakage by closely controlling the annular clearance between the rotating or reciprocating shaft and the relatively stationary housing.
Types:

1. Labyrinth - one or more thin strips or knives attached to either the stationary housing or rotating shaft.
2. Bushing or ring - close fitting stationary sleeve within which the shaft rotates.

Problems such as leakage and rubbing are discussed.

K-045
Kuech, W.
Recent Tests Of Glasses And Sealing Material For Pressurized Cabins
Lilenthal-Gesellschraft Fue Luftfahrtforschung Bericht-129, p. 30
Spec. Lib. Assn. Translation 3221, (13 p.), V. 3, No. 8, Aug. 1957

K-046
Kuhn, H.S.
Rotating Joints
Prod. Engng., V. 27, pp. 200-204, Aug. 1956

Rotating joints, originally designed around familiar packing gland, have become highly specialized for many applications in all industries. They now operate from - 300°F (liquid oxygen) to 700°F (dichlorobenzene) or high temperature superheated steam. They seal water, steam, brine, air, paint, lacquers, refrigerants, diphenol-diphenoloxides, dichlorobenzene, sea water, and air-mud mixtures. The most practical seal material is carbon with stainless steel, monel and high nickel steel mating surfaces.

K-047
Kunkel, E.V.
Selecting Gaskets To Limit Corrosion Of Stainless Steel Bolted Joints In A Chemical Plant
Corrosion, V. 10, pp. 260-266, Aug. 1954

Examples of corrosion of austenitic stainless steel joint surfaces attacked by liquid media penetrating gaskets are described. Author postulates liquids of high electrical conductivity, containing weak oxidizing and reducing agents are principally responsible for the pitting attack of the gasket bearing surfaces. Presence of chloride salts or organic chloride in the gasketing may contribute to stress corrosion cracking of the joint surface. Author concluded corrosion may be controlled by proper selection of gasket material, by proper joint design and by modification of corrosion characteristics of process fluid being handled.

K-048
Kupiec, H.P. (Aircraft Equip. Testing Co.)
Testing Of Metal Boss Seals
PB-119818, Off. Tech. Sev. (67 p.) photo, dia. dwg., April 1955, Order from L.C.

The metal boss seal was conceived by Wright Air Development Center to meet the requirements of hydraulic and pneumatic systems with operating pressures up to 5,000 psi, and temperatures as low as -100°F and as high as 600°F. The application of the new metal boss seal involves the use of a deformable metal ring in conjunction with standard AN hydraulic fittings. This seal is being considered as a replacement for the current standard ANG6290 synthetic rubber gasket. Proj. No. 1371 AF WADC Contract AF33 (600) - 26548.

K-049
Kunze, E.J.
Diesel Engine Upkeep
Power Plant Engineering, V. 36, pp. 601-2, August 1, 1932

Maintenance of packings, gaskets, and engine plant joints. Proper selection of packing materials. Joint types. Proper methods of using gaskets.
Common packing materials are asbestos, cotton, flax, fiber hemp, graphite, rubber lead, babbitt, antimony, aluminum, copper bronze, and cast iron. Common gasket materials are paper, leather, cotton fiber, cork, lead, aluminum and copper.

K-050
Kurek, J., and Simmons, J.
Development Of Secondary Seal For PWR Head Penetrations
Combustion Engineering, Inc., Nuclear Components Engineering Dept., Chattanooga, CENC-1006 CE Contract Nos. 7954-25 and 7954-30, Aug. 1957, 66 p.

The results of the development program which was initiated to design a seal to back-up the primary seal of the pressurized water reactor are presented. This program was divided into three phases: a packing, a welded membrane, and a metallic gasket.

K-051 B
Kurie, F.N.D.
Vacuum Systems, Seals And Valves
Review of Scientific Instruments, V. 19, pp. 485-93, Aug. 1948

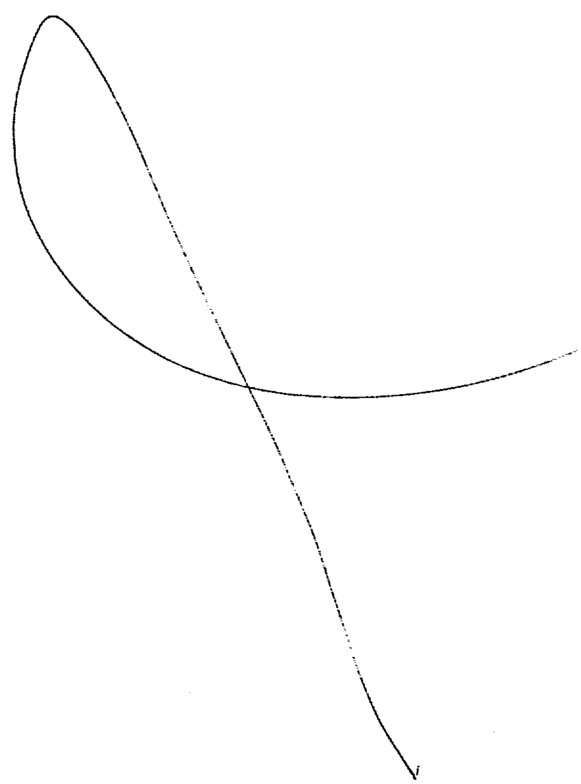
Design suggestions are given for valves, shaft seals, and gasketed joints intended for use in continuously pumped all-metal vacuum systems.
Vacuum valves, gaskets, O-rings.

K-052
Kuskevics, G., and Chappelle, A.
Low Temperature Vacuum Systems
R57AGT751, GEL Tech. Data Center, G.E.Co., Sch'dy., N.Y. (13 p.), Dec. 13, 1957

Vacuum systems operating below 90°K are reviewed. These include storage and transport equipment for liquified gases and cryogenic optical test equipment. A vacuum system for a liquid oxygen flow apparatus and a liquid nitrogen optical dewar are described in detail.
Among materials used for low temperature vacuum system construction, copper, brass, monel, and Kovar austenitic stainless steel are common. All are non-ferromagnetic. They are either soft or silver soldered, arc-welded or brazed. Rubber, grease, and sealing compounds cannot be used because they are hard at low temperatures. Hence only metal O-rings such as lead or solder can be used. Low temperature differential, contraction problems must be considered.

K-053
Kuss, E.
The Physics Of Extreme Pressures (In German)
Chem. Ing. Tech., V. 28, pp. 141-52, March 1956

A comprehensive treatise covering autoclave, gasketing and sealing, pressuring, measurements, equations of state and internal.



L-001
Labber
Cutting Copper Gaskets
Eng. & Mining Journal, V. 137, p. 189, April 1936

L-002
LaBour, H.E.
Improvements In Or Relating To Rotary Shaft Seals And Pumps Provided With Such Seals
British Patent 854,526, Nov. 23, 1960

A seal for the vertical rotary shafts of centrifugal pumps is designed so that the pump can be used for long periods without maintenance other than oiling the motor or shaft.

L-003
Labrow, S.
Design Of Flanged Joints
Institution of Mechanical Engineers Proceedings, V. 156, pp. 66-70, 1947, (discussion, pp. 70-73)

Basis of design adopted by one firm to insure consistency over a wide range of pressures and sizes. Table on gasket factors and yield values for various materials including metals, asbestos rubber, and fabrics, and one on effective gasket width.

L-004
Lange, W.J., Alpert, D.
Step-Type Demountable Vacuum Joint
Review of Scientific Instruments, V. 28, p. 726, Sept. 1957

Flanges are machined from stainless steel and are heliarc welded to vacuum system components. The gasket is a washer-shaped ring of O.F.H.C. copper about 0.040 in. thick. It is hydrogen annealed at 950°C after cutting. This flange has the advantages over knife edge type seals in that the steps are much more easily machined and the tolerances are less stringent. Advantages discussed, drawing included.

L-005
Lankester, J.A.
Bonded Seals
Appl. Hydraulics, V. 7, pp. 69-71, May 1954

Designers of hydraulic components, both aircraft and industrial, have sought a means of providing a reliable and durable static seal. The bonded seal is a result of this search. Applications discussed.

L-006
Larkin, R.G.
Evaluation Of High Temperature Hydraulic Seals To Temperatures Of 550°F. Part II Polymer Compounding And Evaluation
WADC Tech. Report 57-76, Feb. 1958

L-007
Larson, A.W.
High Pressure O-Ring Piston Packing
Res. Sci. Inst., V. 25, p.1136, Nov. 1954

The application of multiple O-rings to a piston to prevent leaks at 10,000 atmospheres for long periods of time.

L-008
Leach, L.L.
Seals For Shaft Housings And Bearings
Product Eng., V. 3, pp. 123-4, March 1932

Typical seal designs suitable for three general purposes: (1) to retain lubricant; (2) to keep out foreign matter and; (3) to prevent leakage of liquids or gases through clearance space between rotating shaft and housing.

L-009 T
Ledwith, W.A.
Bearing And Seal Assembly For Turbines
U.S. Patent 2,469,734, May 10, 1949

A bearing and labyrinth seal assembly designed to be installed as a unit.

L-010
Lee, J.
Metallic Seals For Extreme Temperature-Pressure Applications
SAE Journal, V. 70, No. 10, pp. 98-99, October 1962

Wedge seals fabricated from recently developed materials have been tested at Republic (Republic Aviation Corp.) to 1000°F and 400 psi for periods up to 17 hours with negligible leakage. Description of several types, with drawings, photos, and results discussion.

L-011
Lehmberg, W.H.
Plain And Laminated Felt Seals: Their Design And Application
Prod. Engng., V. 17, pp. 209-211, March 1946

Design properties of felt seals when used for retention of grease and oil and exclusion of dust fume or moisture are presented in tabular form. Selection of the correct grade in either plain or laminated felt seals is discussed as well as recommended designs for housings.

L-012 T
Lein, J.
Mechanical Test On Sealing Rings For Rotary Shafts (In German)
Konstruktion, V. 6, No. 10, pp. 384-389, Oct. 1954

A discussion of the results of an investigation into rubber and leather shaft seals conducted over a period of years. The paper covers a wide range of design considerations and presents a thorough discussion of factors affecting seal operation. The investigation was conducted at the Automotive Research Laboratory of the Karlsruhe Institute of Technology.

L-013
Lein, J.
Mechanical Tests On Rubber Sealing Rings For Rotating Shafts
Engrs. Digest, V. 16, pp. 59-61, Feb. 1955

Sealing rings made of synthetic rubber, for sealing the interior of a housing against leakage along a rotating shaft, have proved successful even at high rotational speeds, and with differences in inside and outside pressures.

L-014
Lem, D.R., Reynar, J.M.
Stress Relaxation Of Non-Metallic Gasket Material
Bull. Am. Soc. Test Mat. (ASTM), No. 207, pp. 81-85, 1955

A functional test fixture, a testing procedure, and a formula by which numeric values can be obtained for percent stress relaxation for all types of non-metallic gasket materials has been established.
Test data, results, and discussion.

L-015
Lenhart, W.B.
Ball Mill Gaskets
Rock Products, V. 45, p. 55, Sept. 1938

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L-016
Leont'eva, V.P., and Slonimiskii, G.L.
A Study Of Stocks Used For Seals In Units Of Hydraulic Systems Of Airplanes Under Isothermal Compression From All Directions. (In Russian)
Moskov, Aviation Inst. im S. Ordzhonikidge, Sbornik Slater, V. 93, pp. 5-20, 1957, (LC or SLA-Translation No. 59-19477)

Compressibility of cured stocks of nitrile rubbers (natural rubber and SKBS and SKB) was studied under hydraulic pressures of 32-500 atm. at 18-20°C.

L-017
Le Pera, A.A.
Sealing Fluids In Propulsion Systems
SAE Jour., V. 67, pp. 118, 121, Aug. 1959,
Abstract of SAE paper 50U, "Fluid sealing in extreme environments," from meeting of March 31, 1959, 11 p.

Discusses fluids in which propulsion system static and dynamic seals must operate. Elastomer compatibility studies have been made with these fluids which include high energy fuels, extremely corrosive oxidizers, mono-propellants and Cryogenic fluids.

L-018
Le Pera, A.A.
Breakthrough Needed For Extreme Environment Fluid Sealing
Space/Aeronautics, V. 32, No. 2, pp. 50-53, Aug. 1959

Sealing problems on operation from - 400 to + 1000°F are discussed. A breakthrough may come from polymer technology or from heat-resistant elastomeric-inorganic composites.

L-019 T
Lewis, D.R.
Mechanical Seal Failures
Power, V. 89, p. 918, Mid-December 1945

This is an abstract of a paper presented at the ASME petroleum session.
A discussion of failures in mechanical seals, analysis of failures, and remedies, are included.

L-020
Lewis, D.R.
Mechanical Seals, Basic Considerations - Part I
Mach. Design, V. 18, pp. 125-128, Sept. 1946

Comparative merits of stuffing boxes and mechanical seals are discussed along with design considerations of each.

L-021 T
Lewis, D.R.
Mechanical Seals: Classification Of Types
Machine Design, V. 18, pp. 78-82, Oct. 1946

Basic definitions, and photographs of rotating joints, stationary joints, unidirectional forces related to inside assemblies and outside assemblies, single seal, and double seal. Types of seals: packing ring, gasket, helical spring; integral gasket, helical spring; bellows, integral gasket, helical spring, strained member bellows.
Speed, temperature and pressure ranges of each.

L-022
Lewis, D.R.
Mechanical Seals, Application Factors - Part IV
Mach. Design, V. 18, pp. 138-142, 182+, Nov. 1946

The three fundamental rules used in designing mechanical seals are discussed. They are: (1) Life of mechanical seal directly proportional to shaft rigidity. (2) Means should be provided to fasten stationary seal member to machine so face remains flat and normal to axis of rotation. (3) Allow for maximum ease of seal installation, inspection, and maintenance.

L-023
Lewis, D.R.
Mechanical Seals, Theoretical Design - Part IV
Mach. Design, V. 18, pp. 146-150, 184, Dec. 1946

Article relates the heat producing factors in a seal design to see how they can be controlled to minimize wear.

L-024
Lewis, J.W.
An Experimental Study Of The Motion Of A Viscous Liquid Contained Between Two Coaxial Cylinders
Proc. Royal Soc. London, Series (A), V. 117, pp. 388-407

A detailed report of an experimental investigation of the validity of G.T. Taylor's stability criterion for transition from laminar flow to vortex flow. Tests were run from kinematic viscosities varying from 0.006 to 0.018 CM^2/sec. with varying clearances to radius ratios. Photographs of flow patterns are included.

L-025
Lewis, O.L.
Flange, Gasket, And Bolting Materials For Refinery Service
Oil and Gas Journal, V. 49, p. 134, Aug. 24, 1950

L-026 T
Leyer, A.
Wedge Lubrication Or Pressure Lubrication (In German)
Schweizerische Bauzeitung, V. 71, pp. 66-69, Jan. 31, 1953

An analysis is made of the viscosity pump, and the maximum efficiency of such a pump is shown to be 33%. Hydrostatic lubrication is also considered briefly.

L-027
Li, Y.T., Lapp, P.A., Lee, S.
A Flowmeter For Measuring Mass Flow-Rate With A High Speed Of Response
Proc. National Conference on Industrial Hydraulics, V. VII, pp. 218-231, 1953

Includes a brief description of rotary seals used in the instrument.
Rigid perfect seal; flexible perfect seal; clearance seal, plate-type seal, labyrinth seal, mercury or water seal.

L-028
Liberto, R.R.
Research And Development On The Basic Design Of Storable High-Energy Propellant Systems And Components
Bell Aerosystems Company, pp. 1-281, May 19, 1961 (AFFTC TR 60-61)

Includes metals, elastomers, plastics, etc.
Effect of temp., time, pressure, etc.
Seals, materials.

L-029
Lighter, A.W.
Magnetic-Type Mechanical Seals
ASME preprint 59-PET-35, 2 pp., Sept. 1959

Dynamic shaft seal developed to eliminate springs in mechanical seals. Consists of an Alnico 5 magnet ring, rhodium plated for corrosion protection, two O-rings, one stationary and one rotating, and a carbon ring unit.
All types of fluids can be sealed except light, non-lubricating hydrocarbons at high pressures. These produce excessive wear in the carbon. Tests indicate that this carbon wear problem can be solved.

L-030
Likharev, K. K.
Constructional Features Of The Seal Between Parts Moving Relative To One Another In High Pressure Apparatus
Order from L.C. or SLA Translation No. 60-15806

L-031
Lillis, S.M.
Engine Oil Seals Improved To Meet Truck And Bus Needs
SAE Jour., V. 68, pp. 86-87, No. 3, March 1960; from SAE Paper N119T, 1959

New materials, methods, and machinery are being used to make oil seals for bus and truck engines. To illustrate two examples are cited; front and rear crankshaft oil seals.

L-032
Linderoth, L.S., Jr.
Selecting Hydraulic Seals
Mach. Design, V. 16, pp. 119-128, Sept. 1944

How well a given hydraulic packing installation achieves its main purpose of confining hydraulic fluid within the components of the system is a measure of its efficiency. Secondary considerations are friction, life, and ease of service or repair. Frequently it will be found that several different designs of hydraulic packings are equally effective. Article discusses briefly a number of generally accepted designs and related engineering factors.

L-033 T
Lindhardt, P.
The Hydrostatic Gas-Bearing As A Non Touching Gland For Rotating Shafts
Int. Conf. on Fluid Sealing, Paper C2, (8 pp.), April 17-19, 1961

The possibility of maintaining a uniform gap between the sealing faces of a radial face seal by the introduction of a series of pressurized pockets in the stationary face is examined. Expressions giving the gap thickness and condition for high axial stiffness in terms of the sealed pressure and seal geometry are derived, and preliminary results have shown that the seal is capable of operating satisfactorily.

L-034 T
Lindow, A.L., Graff, R.A.
Fluid Seal
U.S. Patent 2,960,332, Nov. 15, 1960

A packing assembly which is capable of self-sealing, automatically repairs damage to the sealing surface. The patent relates to seals for which relative motion is limited such as in fluid springs.

L-035
Linke, J.
Flange Seals For Low Temperature Fluids
V.D.I. Zeitschrift, V. 98, p. 1614, September 1956 (In German)

L-036 T
Llewllyn, W.A., Mealing, J.E.
Development Of Carbon Sealing Ring Materials
Int.Conf. on Fluid Sealing, Paper F4 (14 pp.), April 17-19, 1961, British Hydromechanics Research Assn., Harlow, Essex, England

Discusses amorphous carbon and carbon graphite mixtures developed for sealing rings. Physical, chemical, and running characteristics, wear test results. Running characteristics of carbon graphite as face seals and counterface seals. Sintered metal-carbon-graphite seal face for operation under abrasive conditions.

L-037
Lobanoff, V.
Stuffing Boxes For Centrifugal Pumps
Petroleum Engr., V. 22, pp. C33-4, C36, March 1950

Function of stuffing box is to prevent leakage along shaft; usually, packing or mechanical seal minimizes leakage rather than prevents it completely; majority of high speed centrifugal pumps are still equipped with stuffing boxes fitted with pliable packing as sealing medium; types of stuffing box design.

L-038
Logan, S.E.
Static Seal For Low Temperature Fluids
Jet propulsion, V. 25, pp. 334-340, July 1955

Novel temperature sensitive seal developed by GE Co., consists of a neoprene gasket backed by an Invar insert and the gasket stress increases as the temperature drops and is independent of the original load used for assembly. This system is being investigated for static and dynamic cryogenic sealing down to -452°F.

L-039
Loggie, J.J.
Controlled Confinement Sealing
Hydraulics & Pneumatics, V. 15, pp. 90-91, March 1962

These seals are a valuable development for sealing exotic fluids at high temperatures in aircraft, missiles, and rockets.
Discussion of design factors; forces, time vs. temperature, and compatibility.
Silicone, Viton, buna N.

L-040
Longstrech, C.
Metallic Packings: Principles Of Design Essential For Successful Development
Mav. Engrs., May 1903

Discusses the purposes and requisites of a successful packing, importance of care in design, etc.

L-041
Longstreet, G.B.
Packing Centrifugal Pumps
Power, V. 74, p. 425, Sept. 22, 1931

A brief commentary on improper installation of proper size and material of packing, its effect and correction.

L-042
Lopata, S.L.
Practical Approach To Packing Of Chemical Pumps
Chem. & Met. Engr., V. 51, pp. 104-7, Dec. 1944

A discussion of the characteristics of the various yarns and lubricants employed in packings and how the packings should be installed and explains how to determine when it should be replaced.

L-043
Lorickes, F.I., Jr.
Unique Sliding Seal For Vacuum Chamber
Rev. Scientific Instruments, V. 28, pp. 468-9, June 1957

A scattering chamber having a continuously variable angle of more than 180° between the entrance and exit beams, and having an exit port of sufficient diameter to accommodate a photomultiplier tube was required. The vacuum seal consists of a flexible strip sliding over an O-ring. A 5 mil strip of type 304 stainless steel, with angle stiffness of 0.010, and a 0.139 inch diameter O-ring was used. Details of assembly, and operation are given.

L-044
Loringren, H.E.
Flange Design Considerations: Flanges And Full Faced Gaskets
Petroleum Refiner, V. 27, pp. 117-19, Feb. 1948

L-045
Lucas, L.R., Hernandenz, H.P.
Inflatable Gasket For The 72 In. Bubble Chamber
Review of Scientific Instruments, V. 30, p. 941, Nov. 1959

A satisfactory glass-to-metal seal at liquid hydrogen temperatures has been developed for the large oval shaped optical window of the 72 in. liquid hydrogen bubble chamber. Indium wire is held in contact with the chamber glass by an inflatable stainless steel member capable of 0.160 in. useful deflection. Sealing technique described in detail. Pressures and temperatures discussed. Photograph included.

L-046
Lutz, M.W.
5 Kinds Of Stuffing Boxes For Barrel-Type B-F Pumps
Power Engng., V. 61, pp. 73-76, Sept. 1957

Design and maintenance of stuffing boxes, particularly in boiler feed pumps, has long been a problem for pump manufacturers, as well as for central station operators. Wide range of suction conditions up to 500 psi; speeds up to 9000 rpm or higher and temperatures above 400°F makes the choice of the correct type of stuffing box very important. Knowledge of merits or disadvantages of each type of stuffing box will permit a more intelligent selection of the proper type.

L-047 T
Lyle, C.A., Muller, R.H.
Sealing Means For Rotary Regenerative Heat Exchanger
U.S Patent 2,942,857, June 28, 1960

A radial type labyrinth seal is used to minimize leakage in a rotary heat exchanger,

L-048
Lymer, A.
Mechanical Sealing As It Stands Today
Engng., V. 191, pp. 872-573, April 1961

The several theories of the basic sealing mechanism are explained. Basic seals (balanced and unbalanced) are covered as are the pressure ranges of each (unbalanced up to 150 lbs. per sq. in. and balanced up to 1200 lbs. per sq. in.). Specific applications and future developments are discussed.

L-049 B
Lyon, G.T.
C.N. Metal To Metal Seals End Fluid Leakage In Hydraulic Systems
Proc. 13th National Conference of Industrial Hydraulics, V. 11, pp. 211-4, 1957

L-050
Lyubimov, M.L., Shakhov, K.P., Yukhvidin, Y.A.
Experience In Designing And Manufacturing All-Metal Vacuum Systems
Vacuum, V.9, No. 2, pp. 108-116, May 1959

Late years have seen a clear-cut tendency to replace glass vacuum systems by all metal systems for an obvious reason. We have been working in this direction for the last ten years and the main results of our work form the subject of this report. The subjects dealt with are: (a) the design of demountable, high-vacuum heated joints, (b) design of valves, (c) design of traps.
Types of seals are: (a) conical seals, (b) seals with groove-wedge profiles, (c) seals with a rectangular butt projection, (d) pyramidal seals for rectangular cross sections, (e) seals with a double profile, (f) diffusion seals. Materials: oxygen free copper, annealed in hydrogen; aluminum, gold plated copper gaskets with diffusion seals.
Pictures and drawings.

M-001
Mabbs, J.W.
Packing
American Water Works Assn. J., V. 12, pp. 295-6, Nov. 1924

M-002
MacDonald, K.
Carbon Packing Progress For Sealing Small Turbines
Power, V. 98, pp. 122-123, 200+, July 1954

Article discusses a variety of carbon ring packing glands for turbines together with installation and maintenance problems.

M-003 B
MacDonald, R.J.
Development Of Iron-Base Seal Materials For High Temperature Applications
A.S.L.E. Paper 60LC-11, (8 pp.), October 1960, (Also Trans. A.S.L.E., V. 4, No. 1, pp. 12-19, April 1961).

The results of a series of experiments on the rubbing properties of commercial, high speed, tool steels are described and were obtained for surface speeds between 16 and 150 ft./sec. with ambient temperatures between 75 and 1200°F.

M-004
Machen, J.R.
16 Unusual Applications For The O-Ring
Product Engineering, V. 30, pp. 90-91, Nov. 23, 1959

This handy little component finds a place in pumps, drives, glands, shock mounts, pivots, knobs, valves and seals.
Drawings of 16 examples, with appropriate legend.

M-005 T
Macks, E.F.
Seal
U.S. Patent 2,907,594, Oct. 6, 1959

A cartridge type mechanical face seal which is claimed to provide sealing under extremes of temperature and pressure. Orifices are provided in one face of the seal to permit a pressurized lubricant supply to the sealing film between the seal faces.

M-006
Main, M.M., and Stubenrauch, E.H.
Simple Compression Packings
Mechanical Design, The Seals Book, pp. 51-57, Jan. 19, 1961

Compression packings create a seal by being squeezed between the throat of the box and the gland. Under these compressive forces, the packings flow outward to seal against the bore of the box and inward to seal against the moving shaft or rod. Compression packings require frequent gland adjustments to compensate for wear and loss of volume.
Packing materials include vegetable fibers, mineral fibers, animal products, artificial fibers and metals. Packing lubricant criteria are discussed.

M-007 T
Maisch, O.
Rotary Shaft Seal
U.S. Patent 2,899,244, Aug. 11, 1959

A form of mechanical face seal in which leakage increases the force on the seal.

M-008 T
Malanoski, S.B., Fuller, D.D.
Survey Of Component Requirements And Availability For Gas-Cooled Nuclear Reactor Power Plants - Bearings & Seal
The Franklin Institute, Report I-A2392-8, USAEC Contract AT (30-1) 2512, June 1961

This report is the result of a survey and critical review of the bearings, seals, and bearing and seal systems designed for use in the primary loop components of four gas-cooled nuclear reactors under construction in the United States.

M-009
Manes, J.
Leakage Test On One Voi Shan Test Block N.V.S.D. 1000-8
Wyle Lab., July 1961

Seals, configuration, and testing leakage of material file burner.

M-010
Mann, J.B.
Improved Metal Gasket For Vacuum Systems
Rev. Sec. Instr., V. 27, pp. 1083-4, Dec. 1956

A hydrogen-annealed copper ring with a 90° triangular bead which presses against the flat flange surface opposite a cylindrical bead on flange surface.
Short article and detail drawing.

M-011
Marker, R.C.
Vacuum Techniques And Components Used For A Continuously Pumped Linear Electron Accelerator
Vacuum, V. 9, No. 2, pp. 128-133, May 1959

A vacuum system has been designed to continuously pump a linear electron accelerator having an internal volume of approximately 30 ℓ and produce vacuum down to 1 x 10^{-8} mm. Hg. or better.
Double ridge flange design utilizing copper gaskets.

M-012
Mars, A., Lazav, N.M.
Metallurgical Factors In The Design Of Hydraulic Equipment For Elevated Temperature Application
A.S.M.E. Paper No. 58AV11, January 1958

The metallurgical factors controlling the use of metals for hydraulic application in the temperature range of 400 to 900°F are discussed. Materials available were appraised. Tool steel grade steels show promise. The cast irons show satisfactory structural stability in the foregoing temperature range.

M-013
Marshall, A.
Wide Temperature Range Pump Seal
Rev. Sci. Instr., V. 24, pp. 1151-2, Dec. 1953

A modification has been made to an Eastern Industries Pump, Model EL, enabling it to pump acetone at -78°C and water at 100°C without leakage. The rotor was soldered onto the pump shaft and its semi-conical end seating into the graphite carbon cup constitutes the liquid seal. The carbon cup and its container are a free fit on the shaft, and contact between the rotor and the carbon is maintained by tension in the bellows.

M-014
Marsh, M.G.
Developing Face Seals For Rotating Shafts
Nuclear Engrg., V. 7, pp. 149-151, April 1962

Descriptions, with experimental evaluation data, of progressive improvement of combined thrust bearing and annular face seal originally developed for hydrogen blower on 60 MW turbo-alternator and air-lubricated face seal used in Zenith reactor coolant circuit.

M-015
Marshall, J.
Felt As Bearing Seal
Product Eng., V. 2, pp. 508-9, Nov. 1931

List of factors governing selection of proper type of seal and bearing design; sealing materials and their characteristics; S.A.E. felt standards; characteristics of various types of felt bearing seals.

M-016
Martin, A.J.
Metal Seals In Vacuum Equipment
A.W.R.E. Report No. 0-40/54, August 1954.
(Atomic Weapons Research Establishment)

This report presents some measurements of leakage rates through metal gaskets under various conditions. The materials tested were aluminum, copper, indium, and solid mercury. Seamless wire rings of aluminum and copper tested from liquid air temp. to 400°C for aluminum, 800°C for copper. Limited work with rubber O-rings.

M-017
Martin, G.S.
O-Ring Vacuum Valve For Use With A Visible Flow Industrial Glass Apparatus
J. Sci. Instrum., V. 36, p. 141, March 1959

The body of the valve is attached to the pipe flange by a modified form of Q.V.F. fitting, in which a projecting metal flange on the body replaces the usual metal backing flange. An O-ring between the flat-ground end of the flange and the body of the valve ensures a vacuum tight seal. Descriptive drawing included.

M-018 T
Martin, H.M.
Labyrinth Packings
Engineering, V. 85, pp. 35-36, Jan. 10, 1908

The author used the total energy change of the steam to derive an equation for leakage past a labyrinth seal, assuming: -that when steam is throttled the product of pressure times specific volume is constant; subcritical flow and a discharge coefficient of unity; labyrinth area is constant for all stages. Corrections must be made if critical velocity is exceeded, necessitating trial and error method. Not convenient for design.
No test results.

M-019 T
Martin, H.M.
Steam Leakage In Dummies Of The Ljungstrom Type
Engineering, V. 107, pp. 1-3, Jan. 3, 1919

Accuracy of original formula, of 1908, established, a correction derived to extend its application to series of labyrinths of increasing area. Assumed the diameter of rings increase in arithmetic progression. No graphic data for design use.

M-020
Mason, C.J.
The Story Of Packing: Fibrous And Metallic
South Power Jl., V. 46, pp. 59-64, May 1928,
V. 49, pp. 58-63, July 1928

May: Purpose of packing; kinds of packing; types of self-setting packings; superheat steam packing; hydraulic and pump packing. July: metallic packing; principle involved; flexible fing type; for ammonia; France vanadium metallic packing; description of Cooke seal ring; choosing metallic packing.

M-021
Mason, H.R., and Magina, A.S.
Additional Qualification Testing Of The Soft Seat "Circle Seal" Check Valve, Dwg. No. 733B205
R56AT24, GEL Tech. Data Center, G.E. Co.,
Sch'dy., N.Y., (37 pp.), March 29, 1956

Report presents the results of further testing required to demonstrate conformance with requirements as set forth in Boeing Airplane Co. letter 480-9-34804-461, dated Jan. 9, 1956.
Conclusion: The "Circle Seal" check valve 733B205 met all requirements and is recommended for introduction with the redesigned reservoir pressurization system into the 7T-AP-10B Turbo Hydraulic Pump.

M-022
Mason, J.C.
Mechanical Seals: Design, Operation, Selection, And Application
Plant Eng., V. 13, pp. 123-127, April 1959

Pump seals discussed include internal, external, single, double, unbalanced and balanced seals; gland cooling, lubrication, quenching, venting and draining. Material section includes: C, cast iron, bronze, Ni-Resist, stellite, glass, ceramics, and others.

M-023 T
Mataich, P.F.
Development Of Friction Seal Materials For High Temperature High Speed Operation
Machine Design, V. 29, p. 186, Sept. 19, 1957, (PB-1219440.T.S.) From WADC Tech. Report No. 56-579
ASTIA - AD 118047

New seal materials are being developed for operation at 1000°F and 30,000 fpm, with life expectancies of 1000 hours without measurable deterioration. Reduction of friction, galling, and scuffing are discussed. Development centered around a soft silver phase infiltrated into a porous nickel matrix containing 5-10% of chromium boride, or tungsten carbide. Graphs of wear vs. temperature are included for a speed of 18,000 fpm with 11.5 psi face pressure.

M-024
Matheis, H.C.
Leather Packings And The Pitting Of Stainless Steel
Modern Industrial Press, V. 10, pp. 32, 36, Sept. 1938

It was found that salts present in the leather caused pitting. The same was true for other types of packing material. Use of special impregnating compounds prevented the corrosion.

M-025
Matheis, H.C.
Packings: Their Importance In The Life Of The Press
Modern Ind. Press, V. 5, pp. 48, 50, June 1943

Proper operation of hydraulic and pneumatic equipment predicated upon properly designed packings. Paper lists factors which must be anticipated in the design of a packing. Among these are operating pressure, temperature, operating medium, environment, size, material, etc.

M-026
Matheis, H.C.
Modern "V" Packing Design
Modern Ind. Press, V. 5, pp. 21-22, Aug. 1943

Modern "V" packings have found wide application and success on hydraulic press and aircraft installations. Unique properties contribute to long maintenance free service. Paper cites such properties and application norms to be considered.

M-027
Matheis, H.C.
High Pressure Hydraulic Leather Packings
Modern Ind. Press, V. 7, pp. 26, 30, Jan. 1945

Four standard types of packings used in hydraulic equipment each of which has its place and application. These are flange, cup, "U" and "V" packings. Pressure limitations, material, and space limitations of each is covered.

M-028
Matheis, H.C.
Design And Application Of O-Ring Packings
Modern Ind. Press, V. 7, pp. 24, 26, July 1945

Synthetic O-ring packings when carefully designed and applied to equipment where conditions are suitable are productive of satisfactory results.

M-029
Matheis, H.C.
Design And Application Of Leather Flange Packings
Modern Ind. Press, V. 7, pp. 38, 40, Sept. 1945

Flange packings usually used for small cross sectional widths, where a "U" packing cannot be used and on rods of small diameters where reasonably low pressures prevail. Ideal as oil or grease seals on rotating shafts at a maximum velocity of 1,000 feet per min. Design and application norms considered.

M-030
Matheis, H.C.
Design And Application Of Fabricated Synthetic Rubber "V" Packings
Modern Ind. Press., V. 8, pp. 22, 24, Jan. 1946

Paper describes a fabricated packing which gets its name from being fabricated from synthetic rubber and cotton duck or asbestos. By varying the cures and compounds it can be applied to steam pressure operating up to 700°F and as low as 0°F. It can be applied to pressures up to 10,000 lbs. per sq. in. Various design configurations and their application are discussed.

M-031
Matheis, H.C.
Why Use Mechanical Packings
Modern Ind. Press, V. 10, pp. 24, 26, March 1946

The shape or design of these types is such that the fluid or gas pressure acts on the geometric contour of packing, causing the mechanical action to take place. It is not necessary to exert compression on the packing to cause the proper sealing action.

M-032
Matheis, H.C.
Application And Design Of Homogeneous Synthetic Rubber "V" Packings
Modern Ind. Press, V. 8, pp. 30, 32, 34, May 1946

Synthetic rubber "V" packings are readily adaptable to a rotating seal and can be applied successfully up to a surface speed of 200 feet per minute and a pressure of 750 lbs. per sq. in. Amount of lubrication, type of fluid and the temperature involved are often factors in determining the speed beyond that mentioned which can be used. Temperatures of 65°F below zero to 212°F are not uncommon.
Application tables are included.

M-033
Matheis, H.C.
Leather Packing Expanders; Their Use And Application
Modern Ind. Press, V. 9, pp. 30, 34, 44, Dec. 1947

Article explains difficulty of maintaining softness and flexibility in leather packings for low or built up pressures, after having impregnated the leather packings to render them impervious to the passage of air or the liquid medium used. Metal spring expanders solve this problem, making impregnation unnecessary.

M-034 B
Matheis, H.C.
How To Choose The Proper Packing
Appl. Hyd., V. 3, No. 8, pp. 22-4 and 53, Sept. 1950

Four types of packing: "V", "U", Cup, and O-rings are considered the most effective for high-pressure conditions, and are discussed on the basis of their merits for different applications. The author also briefly considers surface finish and clearance.

M-035
Matron, F.D.
Back Pressure Control Unit Uses Long-Stroke Rolling Seal
Instruments and Control Systems, V. 33, p. 984, June 1960

Drawings and discussion including the rolling diaphragm seal, its advantages.

M-036
Matt, R.J.
High Temperature Metal Bellows Seals For Aircraft And Missile Accessories
Transaction of A.S.M.E. Journal, Paper No. 62-WA-25, 7 pp., Nov. 1962

Seals operating over a wide temperature range require greater precision and design analysis than the standard cartridge seals used in most rotary equipment. Discussion of bellows construction, pressure limits, environmental limits, flatness, when and where to be flat, seal ring retention, mating rings, vibration, materials, relative fatigue rating, weldability, fatigue and failure. Drawings, photograph, and data.

M-037 T

May, E.M.
Rotary Joints With Fluid Seal.
U.S. Patent 2,635,931, April 21, 1953

An invention which makes practical the use of O-rings as rotating shaft seals. The O-ring is forced by the sealed pressure against a stationary sleeve between shaft and housing. The friction forces of the stationary elements on the O-ring are greater than those of the shaft, and the O-ring then remains stationary as the shaft rotates.

M-038

May, E.M.
Pressure Drop Across A Packing Tells The Sealing Story
Applied Hydraulics, V. 10, pp. 110-112, 114, May 1957

Just how a packing works is a question often left to theorists. But here is how one company found out by using an original design of test equipment and showing that pressure drop readings along the pressure path are indicative of sealing characteristics.

M-039 T

Mayer, E.
Double-Acting Axial Slip Rings In The Chemical Industry (In German)
Chemical-Ingenieur-Technik, V. 32, pp. 285-288, 1960

The usual equation for the leakage rate of mechanical seals, which was derived assuming laminar flow, non-contacting walls, and no relative velocity, is discontinued. A new equation in which leakage is a function of the square of the gap height is developed. It is also noteworthy that the sealing width does not appear in the new equation, as it did in the laminar equation.
Practical experiences and test results with double seals are described with emphasis on material and construction.

M-040

Mayer, E.
Leakage And Wear In Mechanical Seals
Mach. Design, V. 32, pp. 106-113, March 3, 1960

How to reduce seal leakage and wear; their causes; leakage rate calculations; recommended design practices.

M-041

Mayer, E.
Resistance To Thermal Stress Cracking Of Materials, Used For Unbalanced Mechanical And Circumferential Seals (In German)
VD1 Zeit, V. 102, pp. 728-32, June 21, 1960

Methods of computing resistance of individual materials and pairs of materials used in slide ring seals; tabulated data to facilitate computing "resistance factor" of plastics, synthetic and natural graphite, metals and alloys, and metallic oxides and carbides.

M-042 T

Mayer, E.
Loaded Axial Slip-Ring Seals For Liquids (In German)
Konstruktion, V. 12, No. 4, pp. 147-155, 1960, V. 12, No. 5, pp. 210-218, 1960. See also: Int. Conf. on Fluid Sealing, Paper E2, April 17-19-1961

Extensive investigation covering three fluids, five pairs of materials. More than 20,000 hours operation. It is concluded that the flow and friction processes in mechanical face seals under normal operating conditions cannot be expressed by known formulas of hydrodynamics.
A new empirical equation is presented in which leakage varies with the square of the distance between faces and inversely with the square of the face pressure.

M-043 T

Mayer, E.
Leakage And Friction Of Mechanical Seals With Special Consideration Of Hydrodynamic Mechanical Seals
Int. Conf. on Fluid Sealing, Paper E3, 14 pp., April 17-19, 1961, British Hydromechanics Research Assn. Harlow, Essex, England

Standard balanced and unbalanced seals normally perform under boundary lubrication conditions. To increase the pressure - velocity limitation of present seals, it is necessary to reduce the coefficient of friction and increase cooling and heat dissipation. Investigations at pressures up to 3000 psi show relationship between friction and leakage and advantages of hydromechanical seals. New leakage and design formula and flow constants discussed.

M-044

Mayhew, W.E.
Design And Test Of A High Temperature Hydraulic System
National Conference On Hydraulic Testing, V. XV, pp. 17-27, Oct. 19-1961

A double stage dynamic seal is discussed. Pressure 1000 psi, at 1000°F fluid temperature.
Tests compare results after 5 1/2 hours run.

M-045 T

McArd, R.W.
Some Typical Metallic Packings
Power and Works Engineer, V. 39, No. 457, pp. 155-158, July 1944

The value of application of metallic packings for sealing reciprocating rods and rotating shafts is discussed, and some representative examples are illustrated.

M-046

McCarthy, P.B.
Air Leakage Through Labyrinth Seals
U.S. Atomic Energy Commission, April 18, 1955

M-047 B

McConnell, D.B.
Control Of Leakage In Taper Pipe Threads
Proc. 7th National Conference Industrial Hydraulics, V. 5, pp. 105-111, Nov. 1951

Analysis of the conditions that contribute to leaking of taper thread joints. Special taper joints are discussed as cures. Test results are discussed. No data.

M-048

McCray, C.R.
Radial Positive-Contact Seals
Machine Design, The Seals Book, pp. 9-14, Jan. 19, 1961

A radial positive contact seal is a device which applies a sealing pressure to a mating cylindrical surface to retain fluids and sometimes exclude foreign matter. Rotating shaft application most common but also applied to oscillatory or reciprocating motion.
Various types are discussed together with seal selection criterial and their significance.
Attendant problems - cause and cure - is also covered.

M-049
McCuistion, T.J.
How To Eliminate Problem Of O-Ring Leakage
Applied Hydraulics, V. 2, pp. 14, 20-1, Feb. 1949

Leakage problems encountered in application and installation of O-rings; remedies for control or elimination.

M-050 B
McCuistion, T.J.
The Correct Use Of O-Rings On Valve Seats
Appl. Hyd., V. 1, No. 11, p. 19, Dec. 1948

M-051
McCuistion, T.J.
Floating Gland Design For Long O-Ring Life
App. Hydraulics, V. 4, pp. 59-60, 90-91, Sept. 1951

Floating gland design result of study aimed toward increasing packing life. Design presents entirely new size relationship of piston grooves and cylinder bores to packing sizes. Previous theories of what was considered to be optimum "squeeze" do not apply.

M-052
McCuistion, T.J.
A New Rotary Seal For High Speed And High Pressure Applications
India Rubber World, V. 125, pp. 575-578, 581, Feb. 1952

Describes theory and experimental details in the development of the seal. Includes a consideration of compound characteristics. Referred to as R"O"TO seals. They are fabricated from a type of synthetic rubber.

M-053 B
McCuistion, T.J.
O-Rings In Rotary High Speed Applications
Applied Hydraulics, V. 5, No. 7, pp. 68-71, 106, July 1952

The author claims to have successfully used oversize rings under peripheral compression, and gives details of a number of severe condition tests. Also includes useful information concerning the seal materials, groove dimensions, and shaft surface most suitable for the use of O-rings for rotary motion.

M-054
McCuistion, T.J.
New Gland Design For High Temperature Aircraft Hydraulic And Pneumatic Seals
Committee A6, Aircraft Hydraulic and Pneumatic Eq. SAE-conf., April 27-29, 1955

M-055
McCuistion, T.J.
O-Ring And Gland Design For High Temperature Seals
Prod. Engng., V. 27, pp. 151-155, Jan. 1956

Factors affecting the design of glands for sealing reciprocating or rotary motion under extremes of heat and pressure; requirements for seal material, gland design, lubrication, loading and surface finish are covered.

M-056
McCuistion, T.J., and Allen, R.E.
Factors Influencing O-Ring Operation
Applied Hydraulics, V. 3, pp. 12-4, June 1950

Design problems considered including dimensions, tolerances and clearances, stretching, stress cracking, etc; points to check in selection of O-ring compounds.

M-057 B
McCuistion, T.J., Schaube, E.M.
O-Rings Cure Data And Age Control
Applied Hydraulics, V. 10, No. 4, pp. 114-7, April 1957

This article provides ready reference charts with latest changes in the cure data life of O-rings for hydraulic applications, as specified by military services.

M-058
McCuistion, T.J., Teree, B.R., Pollard, F.H.
New Hydraulic Fluids And Seals
SAE Journal, V. 63, pp. 45-47, Sept. 1955

Review of hydraulic fluid problems; temperatures from -65°F to 400°F; silicone and neoprene rubber seals; seal design materials and techniques.

M-059
McCuistion, T.J., and others
Research On Aircraft Hydraulic Packings
SAE Journal, V. 2, pp. 227-233, 267, April 1948

Report covers survey of hydraulic packings, especially O-ring seals. Covers friction studies, torsional strength tests, plasticizer development, a study of rubbers, molding technique, and spiral failure.

M-060
McCutchan, A.
Gasketed Joints For High Pressure High Temperature Piping Service
Heating-Piping, V. 13, pp. 423-7, July 1941

The author points out that various types of gaskets can be used with good success provided flanges and bolting are sufficiently heavy. It is important to estimate the size of bending moments acting on flanged joints, because their magnitude has a pronounced effect on the ability to keep such joints tight. The effect of water, creep failure are discussed.
Drawings, tables, photos included.

M-061
McGeary, F.M.
Standardization Of Packing Materials For Naval And Marine Machinery
Am. Soc. Nav. Engrs. Jour., V. 41, pp. 563-588, Nov. 1929

M-062
McIlivraith, P.L.
Selection Of Axial Shaft Seals
Mat. in Design Engng., V. 2, pp. 90-94, Feb. 1959

Characteristics and factors for selection of seals whose basic components comprise stationary rubber ring, rotating seal ring, static seal, and pressure ring; advantages of use include elimination of wear on shaft, control of fluid leakage, long service life, reduced power absorption, and ability to compensate for shaft vibration, eccentricity and end play; application to handling of gases and liquids.

M-063 T
McLaughlin, R.W.
Bearings And Lubrication For High Speed Machinery
Product Engineering, V. 19, pp. 108-112, Dec. 1948

This article treats in a practical way the general requirements of the lubricating system of large high speed machines such as compressors, turbines, and generators. Components for adequate system are discussed. The shaft seal system and other requirements are noted.

M-064
McLean, D., Farmer, M.H.
Measurement Of Force Required To Pull Through A 1 Inch Dia. Wilson Vacuum Seal
J. Science Instrum., V. 30, p. 293, August 1953

The construction of a Wilson vacuum seal, as an alternative to the mercury seal, is described, and its frictional resistance to pulling determined. For an adequately greased seal this was found to be about 1/4 kg, which could be ignored in tensile creep test in vacuum (loads 100 to 500 kg) on copper and other materials liable to hydrogen contamination.

M-065 T
McNair, D.G.
Pump Glands In Operation
Power Engineering, V. 29, No. 345, pp. 453-456, Dec. 1934

This article discusses practical problems arising from centrifugal pump service conditions. Special liquids are considered.

M-066
McSwiney, A.
Steam-Engine Packing
Mech. Eng., V. 9, pp. 739-744, May 31, 1902

A description is given of various forms of metallic packings and stuffing-boxes.

M-067
Mehnert, K.
The Consideration Of Thermoplastic Properties Of Fluoro-Polymers As Gasket And Packing Materials (In German)
Chem. Ing. Tech., V. 27, pp. 284-6, 1955

Deformation behavior of Teflon and Kel-F polymers under static loading at 20 to 140°C and pressures of 25-150 Kg/sq. cm. is compared with behavior of rubber.

M-068
Merkel, E.
Fluorine-Containing Ethylene Polymers As Gasket And Packing Materials (In German)
Chem. Ing. Tech., V. 27, pp. 279-83, 1955

A discussion of the various applications of Teflon and Hostaflon with many diagrams and figures.

M-069
Meyer, R.
Gasketing Of Flanged Connections For Ultra High-Pressure Service
Mach. Design, V. 28, pp. 109-112, Nov. 1, 1956

Article is concerned chiefly with flanged connections for pressures above 10,000 psi, an area that may be labeled as ultra-high pressure.

M-070 T
Michel, R.G.
Flooded Bearing Seal For Gas-Filled Machines
U.S. Patent 2,899,245, August 11, 1959

A sealing system for bearings on gas filled machines. The bearing is used as the seal, with a forced oil supply entering between inner and outer portions of the bearing with sufficient pressure and flow to prevent gas from flowing counter to the oil.

M-071
Middleton, R.E.
Hydraulic And Pneumatic Problems In High-Performance Aircraft
Applied Hydraulics, V. 9, pp. 98-101, Dec. 1956

General discussion of problems of temperatures of 400 to 600F. Suggests metal seals will be required.

M-072
Middleton, R.E.
O-Ring Packing Leakage
Lockheed Field Serv. Dig., pp. 10-15, Jan.-Feb. 1957

Discussion of the development of seals and back-up rings for aircraft hydraulic systems, and methods of evaluating leaks around O-rings.

M-073
Middleton, R.E.
O-Ring Packing Leakage
Flight Safety Found., Av. Mech. Bul., pp-4-8, 18, 19, March-April, 1957

M-074
Milleron, N.
Utilization Of The Surface Tension Of Liquid Metals In Making High Vacuum Seals
UCRL-4938, U/CAL Radiation Laboratory, Aug. 30, 1957

M-075 T
Miner, J.A.
Rotary Shaft Seal
U.S. Patent 2,265,951, Dec. 9, 1941

A seal designed for track rollers on track laying vehicles. A floating ring mounted with resilient gaskets on O-rings in the roller, presses against a stationary ring joined to the main shaft and housing by a tube of resilient material which fits into the grooves on the side of the ring and housing, and is concentric to the main shaft.

M-076
Minter, V.A.R.
Getting The Right Pump Packing
Power, V. 84, pp. 256, 257, April, 1940

M-077
Mitchell, C.J.B.
Recent Solutions To Pumping Problems
Chem. Engng. Prog., V. 50, pp. 431-435, Sept. 1954

Reviews several sealing devices which provide long life, uninterrupted service, and inexpensive replacement of a minimum of parts.
Problems pertinent to chemical industry.

M-078 T
Mitchell, T.
Refrigeration Note Book: Tips On Stuffing Boxes And Special Shaft Seals
Power, V. 88, p. 397, June 1944

Maintenance hints on compressor stuffing boxes and shaft seals.

M-079 T
Miyadzu, A.
Theory Of The Westco Type Rotary Pump
Trans. Japan Soc. Mech. Engrs., V. 5, pp. 109-115, Feb. 1939

This article not available for review as of March 1, 1962.

M-080 T

Miyadzu, A.
Theory Of The Viscosity Pump
Trans. Japan Soc. Mech. Engrs., V. 9, pp. 85-96, pt. 3, Nov. 1943

This article not available for review as of March 1, 1962.

M-081 T

Mochel, N. L.
Carbon Gland Rings
Power Plant Engineering, V. 42, p. 624, Oct. 1938

The use of renewable sleeves of hard stainless steel under the carbon or heavy chromium plating of the shaft to prevent pitting and thus ring wear, is suggested.

M-082

Moffett, J.A., and Panagrossi, A.
Silicone Rubbers: New Gasketing Materials For High-Temperature Uses
Mach. Design, V. 18, pp. 109-113, Sept. 1946

Comparison drawn between silicone and natural rubbers for heat resistance, dielectric strength, moisture and chemical resistance and volatility. Applications cited in X-ray, aircraft, steam generator, gas cylinder and oil burner devices.

M-083 B

Molyneaux, F.
A Simple Mechanical Seal For Pumps Or Agitators
British Chem. Eng., V. 5, No. 9, p. 663, Sept. 1960

M-084

Moncher, F. L.
Hydraulic Components And System Considerations For High Mach. Flight
A.S.M.E. Paper 57-A-223, Dec. 1957

High Mach. flight leads to increased use of automatic controls. Hydraulics is particularly adapted to this application because of the inherently fast response. Severe development problems exist, resulting from high temperatures induced by aerodynamic heating.

M-085

Moncher, F.L., Taylor, L.D.
Designing And Testing For High-Temperature Hydraulics
A.S.M.E. Paper 58-A-V-6, December 1957

Development of hydraulic equipment for high temperature applications involves considerable modification in present designs and specialized testing techniques. The test procedures and facilities for evaluation and qualification of hydraulic equipment suitable for use at temperatures in excess of 400°F are complicated, difficult to control, and expensive.

M-086

Monich, M.T., and Bragdon, C.T.
Properties Of Integral Seal Ball Bearings
Gen. Motors Eng.-Jour., V. 4, pp. 8-15, July, Aug., Sept. 1957

Contact and clearance type seals; properties of felt or synthetic rubber seal materials, relative seal efficiency according to grease retention, wet contaminant exclusion, and dry contaminant exclusion tabulated; how design factors of final device affect sealed bearing use.

M-087

Monroe, P.H.
Description And Operational Aspects Of Main Helium Circulators For The 40-MW(e) H.T.G.R. Plant
Nuc. Sci. Abst. 28386 (V. 16, No. 20, p. 3713, Oct. 31, 1962), (Gen. Atomic Div., Gen. Dynamics Corp., San Diego, Calif.)

A general description including operational aspects of the main gas coolant circulators is presented for 40-MW(e) HTGR plant. Included are discussions of the main coolant system, circulators, shaft seal system, drivers, lube system, and operation.

M-088

Montgomery, W.J.
Chromate Gasketing
Sheet metal worker, V. 36, pp. 41-42, Feb. 1945,
Same-Marine Eng., V. 50, p. 200, April 1945,
Same-Iron Age, V. 155, p. 61, Feb. 5, 1945 (cond.)
Same-Chem. Inc., V. 56, p. 86, Jan. 1945 (cond.)

East of cutting, resistance to fire and water make the chromate gasket more than a substitute for war-scarce rubber gasketing.

M-089 B

Moore, C.F.
Compression Packings - Using The Right Ones
Plant Engineering, V. 13, 6, pp. 105-7, June 1959

M-090

Moore, H.R.
Demountable Vacuum Seal For Attaching An End-Plate To A Glass Tube
Rev. Sci. Instrum., V. 29, No. 8, p. 737, Aug. 1958

Although designed originally for attaching glass and quartz windows onto glass discharge tubes, the seal should be effective with other combinations of material. Rotation of a knurled lock ring causes a 45° bevel on the collar to press against an O-ring, the collar sliding freely on the tube. Equal pressures are then transmitted by the O-ring to the surfaces to be sealed, the outer tube surface and the inner surface of the end plate.

M-091 T

Moores, J., Marsh, M.C.
The Effects Of Eccentricity And Flatness Of The Sealing Face Of A Carbon Mechanical Contact Face Seal
Int. Conf. of Fluid Sealing, Paper H1(9 pp.), April 17-19, 1961, British Hydromechanics Research Assn., Harlow, Essex, England

Test results confirmed that variations in performance of nominally identical seals might be due to small differences in eccentricity, the eccentricity encouraging a film of lubricant between the faces.

M-092

Morfey, D.S.
Improvements Relating To Seals For Pressure Vessels
British Patent 856,952, Dec. 1960

A seal of the same type as the ordinary ring seal but without a tendency to leak is designed comprising a T-shaped groove in the closure member and a resilient ring or gasket formed with lateral ears to retain it in the groove.

M-093
Morgan, H.E.
Review Of Turbine Sealing Methods
Power Engng., V. 61, No. 7, pp. 78-79, July 1957

Features of labyrinth seal, designed for modern turbine operation, which consists of thin strips of metal with spaces between them that project to shaft; use of carbon rings in combination with labyrinth seal acting as pressure breakdown; complete gland seal for shaft ends; exhauster system; use of brushing and flexible metal packing to prevent leakage at valve stems; multiple bushing or floating ring seal assembly for range beyond 850 psig and 1000°F.

M-094
Morgan, P.G.
Radial Compression: The Effect Of Low Temperatures On Rubber Packing Rings
Rubber Journal and International Plastics, V. 136, No. 22, p. 872, June 6, 1959

Cooling of rubber seals brings about a decrease in radial force, the amount depending upon the initial compression.

M-095 T
Morgan, R.E., Hummer, H.B.
Mechanical Shaft Seals-Their Pressure-Velocity Limitations
Petroleum Engineer, V. 28, pp. 34-38, Nov. 1955

Description of balanced and unbalanced seals. Test results on face materials. The authors assigned a P. V. rating to each face material and fluid combination. This P.V. rating, when divided by peripheral speed in ft/min. gives the maximum contact pressure limitation in psi.

M-096
Morris, A.E.
Temperature Control In Hydraulic Systems
Applied Hydraulics, V. 10, pp. 68-85, August 1957

Report on methods for determining how much heat will be generated, whether auxiliary oil coolers will be required, and how to select these and other controls. Also, heat generation, temperature effect on fluid packings, natural heat dissipation, system design to reduce heating, oil cooling, immersion heaters, automatic temperature control.

M-097
Morris, R.E., Hollister, J.W.
Plasticizer For G-R-S Gasket Stock To Be Used At Low Temperatures
Rubber Age, V. 70, pp. 195-203, Nov. 1951

Plasticizers were tested in G-R-S stock for extractability by water and volatility. Several G-R-S stocks containing different plasticizers were checked for compression set at -60°, - 30°, 0°, and + 30°F after various recovery times. Data are graphed.

M-098
Morris, R.E., Hollister, J.W., Shew, F.L.
Butadiene Polymers For Low Temperature Service
Ind. & Eng. Chem., V. 43, pp. 2496-2500, Nov. 1951

The purpose of this investigation was to determine whether or not Butadiene-styrene co-polymers with different ratios constitutes a different polymerization temperature than standard GR-S and/or are better rubbers for the manufacture of gaskets for low temperature service than standard GR-S. The Butadiene-styrene co-polymers tested totaled 34. The cold compression set test was performed at -35°F for evaluation. Test results on experimental stocks are presented in table and graphical form.

M-099
Morris, T.R.
Metal Gaskets Should Not Be So Large As To Extend To The Flange Bolts
Coal Age, V. 18, p. 171, July 22, 1920

M-100
Morrison, J.B.
O-Rings And Interference Seals For Static Applications
Machine Design, V. 29, pp. 91-94, Feb. 7, 1957

Interference seals such as the familiar O-ring, are widely employed for static sealing in nearly all pressure ranges. Mechanics of such seals is little known. Article gives mathematical analysis of interference seals, design formulas, and describes a recently developed application.

M-101
Morrison, W.M.
New Approach To Hydraulic Seal Design
Compressed Air & Hydraulics, V. 27, No. 316, pp. 277-9, July 1962

Polytetrafluoroethylene working surface allied to synthetic rubber support in specific dimensional relationship is used as combination of materials for seals; tests of sealing in variety of applications throughout temperature range of minus 80°C to 220°C at pressures from 0 to 4000 psig showed low friction coefficient compared with conventional types; seals are suitable for variety of hydraulic fluids including inflammable oils.

M-102
Morrow, J.
Theory Of Labyrinth Packing
University of Durham-Philosoph. Soc. Proc. 3.5, pp. 281-285, 1909-1910, Engineering, V. 90, p. 136, July 22, 1910

Although the clearance between each strip and collar is reduced to the lowest practicable limit, steam passes through each clearance space at high velocity, but this velocity is destroyed by eddying in the spaces between the strips. A part of the drop pressure is thus consumed at each clearance. The mathematical equations required in this method of calculation are similar to those used for the flow of steam through orifices, those for the energy; for those portions throughout which the flow is assumed to be adiabatic. From these are derived equations for velocity and weight of steam. The application of this theory to the design of labyrinth packings and to the calculations of the pressures at the various clearances follows.

M-103
Moslander, K.P.
New Designs Broaden Scope Of Shaft Seals
Mach. Design, V. 12, pp. 44-7, Nov. 1940

Various types of face seals are discussed; seal noses impregnated with different metals depending upon operating conditions of temperature and load; metallic bellows seals; rubber or synthetic diaphragm type of seal; lubricating problems; illustrations of the various seals.

M-104
Motz, W.H.
Ammonia Compressor Rod Packing
Power, V. 53, pp. 543-545, April 5, 1921

Describes the principle of packing:
(a) the use of separating oil films,
(b) requirements of a good packing,
(c) types of packing,
(d) the merits of packing
Metallic packings vs. fibrous packings.
No data.

M-105
Motz, W.H.
Packing For Refrigerating Machines
Power Pl. Engng., V. 31, pp. 363-366, March 15, 1927

Describes representative types and discusses their operating characteristics.

M-106
Mowers, R.E.
How The New Propellants Affect Plastics And Elastomers
Mat. in Design Engrg., V. 50, pp. 89-91, Sept. 1959

Graphs show quantitatively the effects of the new storable missile propellants on properties of usable elastomers and plastics. Reference is made to CFE fluorocarbon resin as being the most desirable material for lip seals. Despite this, many lip seals removed from disassembled valves after actual service in hydrazine fluids have shown radial cracks. Such failures are believed to have been caused by the combination of internal stresses in the molded seal and exposure to the fuel. A possible solution to this problem is to fabricate seals by postforming from sheet stock. Parts then stress relieved prior to final dimension.

M-107
Moyer, W.H., and Piotter, E.C.
Flexitallic Gaskets For Mechanical Closures
Babcock and Wilcox Co. Res. and Devel. Dept. BW-5409, 39 pp., Jan. 2, 1956

Leakage rates have been determined for two types of flexitallic gaskets. Test fluids were water and helium. Test conditions included temperatures up to 500°F and pressures up to 2500 psi.

M-108
Mueller, M.H.
Vacuum Seal For Thin Metal Windows
Rev. Sci. Instr., V. 27, p. 411, June 1956

A method is presented for vacuum sealing of thin metal windows such as the BE windows in high-temperature X-ray cameras; a modification of the O-ring type seal was developed for curved windows.

M-109
Muller, E.
Compressed Oil Operation Of Tube And Bar Extrusion Presses For The Processing Of Heavy And Light Metals
Zeitschrift fur Metallkunde, V. 46, No. 1, pp. 11-16, Jan. 1955 (In German)

Design and operation of high-power oil pumps whose advantages are reliability, simple packing design, and absence of corrosion.
Photographs, drawings.

M-110
Muller, W.
High-Pressure High-Stroke Diaphragm Mechanism
Engineer, V. 198, pp. 602-3, Oct. 29, 1954

Flexible diaphragms enable a complete seal to be provided between two chambers and at the same time allow axial movement (e.g. for control purposes) to be transmitted from one chamber into the other. Can be used with a combination of liquids and gases.

M-111 T
Mullner, F.
Seal For Rotary Shafts Of Gas-Cooled Machines
U.S. Patent 2,743,948, May 1, 1956

A carbon ring seal. Two rings of rectangular carbon blocks are used, with individual blocks of each ring positioned by separating wedges on an adjacent radial plate. The outer plate contains a set of springs which cause the two sets of carbon blocks to bear against each other and the two rings are positioned so that the blocks on each cover the spaces between the blocks on the other. A rubber ring with a garter spring around it causes the blocks to bear against the shaft and effects a static seal between the two plates holding the carbon blocks.

M-112
Murray, E.A.
Molding Gaskets For Feed Valves
Railway Mechanical Eng., V. 90, p. 320, June 1916

M-113
Murray, J.
Effect Of New E-P Lubes On Elastomers For Oil Seals
Lubrication Eng., V. 15, pp. 140-143, April 1959

Discussion of chemical effects of oil and chemical additives on elastomer seals.

N-001
Nakagawa
Ramsbottom Packing Rings
Engineering, V. 98, p. 130, July 24, 1914

Packing rings made under various conditions are allowed to press small blocks outward against the inside of a cylinder, and the force necessary to slide the blocks is taken as a measure of the normal pressure exerted by the ring. The polar curves of pressure are all symmetrical about a line and have five pronounced lobes. The author suggests a new design of a ring, the inner profile of which consists of two semicircles of unequal diameter and unequal eccentricity with regard to the outer circle.

N-002 T
Naka, H., Kawasaki, H.
On the Experimental Results Of A Viscosity Pump
Jnl. Japan Soc. Mech. Engrs., V. 46, No. 310, pp. 11-13, 1943

This article not available for review as of March 1, 1962.

N-003 T
Nau, B.S., Turnbull, D.E.
Some Effects Of Elastic Deformation On The Characteristics Of Balanced Radial Face Seals
Int. Conf. on Fluid Sealing, Paper D3 (8 pages), April 17-19, 1961
British Hydromechanics Research Assn., Harlow, Essex, England

When a relatively small amount of pressure balancing is used in design of radial face seals, they are able to run with a very thin fluid film separating the faces. Test results show that with local deformations on the face, the film is capable of supporting a greater load than predicted when no deformation occurs.

N-004
Navarre, N.L., Stevens, R.W.
High Pressure, High Temperature Steam Flange Type Joint Sealed With A Flexitallic Gasket
ESE Report 6A66781, U.S. Naval Engineering Station

N-005 B
Naw, B.S.
A Reconsideration of Pressure Generation in Radial Face Seals
British Hydromechanics Research Association, RR699 (244 pp), Sept. 1961

First, a non-mathematical account of the present situation regarding the phenomenon of pressure generation and inward pumping as they affect radial face seals. Second, the formal presentation of mathematical analysis of radial face seals and expressions for the distribution of averaged pressure and the load carrying capacity are derived. Discussed also is coefficient of friction of misaligned seal.

N-006 T
Naylor, H.
The Use Of Mechanical Seals
Steam Engineer, V. 26, pp. 17-19, Oct. 1956

The design and application of mechanical seals are briefly discussed.

N-007 T
Nazio, C.H.
Liquid Seal
U.S. Patent 2,288,638, July 7, 1942

A seal for a vertical shaft in which mercury is used as the sealing means.

N-008
Neef, W.
Stuffing Box Packing (In German)
Gummi-Ztg., V.51, pp. 1213-4, Dec. 17, 1937

Selection of suitable packing; problem of price; directions for use of self-lubricating packing; failure of packing.

N-009
Neer, N.G.
Gland and Stuffing-Box Practice
Mech. Wld., Dec. 25, 1914

Illustrates and describes types.

N-010
Neild, A.B., Jr.
Development Of Cylinder Water Seal to Prevent Diesel Engine Crankcase Cavitation Erosion
SAE Jour., V.68, pp. 64-65, July, 1960

Failure of several crankcase designs studied at U.S. Naval Eng. Experiment Station; test procedure involving use of soft test plugs for rapid evaluation of possible corrective measures required for 600-hp aluminum crankcase; development of special cylinder liner water seal with seal bands of different Paracril BLT compounds; seal strength was adequate for at least 3000-hr. engine operational periods.

N-011 B
Neou, C.Y.
Pressure Actuated Cylindrical Diaphragm Seals
A.S.M.E. Paper 59-SA-1, (9 pp), June, 1958

Analytical formulas and charts are developed for the rational designing of a thin-walled metallic cylindrical shell or band welded peripherally to the inside of a valve body. The flexible sealing band can be inflated to provide a positive contact seal when the valve is in a fully-closed position and deflated to allow for contact-free seating and unseating of the valve disc.

N-012
Nester, R.G.
High Speed Flexible Blade Stirrer and Stirrer Seals for High Vacuum Use
Rev. Sci. Instr., V.27, pp. 1080-1, Dec., 1956

Operation of the stirrer under high vacuum is made possible by a simple, highly effective combination seal and suspension bearing seat that is made of a plug of self-lubricating plastic such as nylon, Teflon, or polyethylene. The passage through the plug, wide at the top, narrows down to form an inverted conical bearing seat. The bearing is an inverted conical, hardened stainless steel bead on the shaft of the stirrer and gives a very effective rotary seal that adjusts itself for slight wear or misalignment.

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N-013
Newell, G.C.
Preliminary Results of All Metal Boss Evaluation and Development
Boeing Aircraft, Transportation Division, pp. 1-11, Sept., 1961

Drawings showing different manufacturers' seals.

N-014
Nielsen, A.T.
Centrifugal Pumps for Process Use
Chemical and Metallurgical Engineering, V. 49, No. 3, pp. 90-2, March, 1942

A number of extremely useful ideas for increasing the life of pumps operating under severe conditions, and for facilitating inspection and maintenance.

N-015
Niemeier, B.A.
Seals to Minimize Leakage At High Pressure
ASME Trans., V.75, pp.369-379, April, 1953

Fixed and moving seals used in super-pressure range of 10,000-100,000 psi are studied and evaluated. Discussion of theoretical problems in confining pressures of great magnitude precedes methods of designing seals. A method and device for evaluating seals developed. Practical seal problems and applications are shown.

N-016
Niessen, P.F.
The German Gasket Industry
PB 48421, Off. Tev. Serv. (13 pp.), October, 1946

Summarizes the processes, materials, and equipments used in production and development. Outstanding developments consist of cylinder head gaskets made from Buna or synthetic rubber and steel, and the manufacture of three meter wide sheets of compressed asbestos packing and curing or vulcanization of oil seal diaphragms at high temperatures. The complete absence of graphite in the oil seal compound and the method and equipment used for determining the running or sealing characteristics of oil seals is of special interest.

N-017
Niessen, P.F.
Amendment To Fiat Final Report #951
PB L-48421-S, Off. Tech. Serv. (Supplement to PB 48421), June, 1947

This report contains two drawings by the Victor Manufacturing and Gasket Co. One on an oil seal diaphragm manufactured by Carl Freudenberg, of Weinheim, Germany. The other illustrates various oil-seals manufactured by Carl Freudenberg. Under the trade-name of "Summering," all embody the same characteristics. An experimental mold was made and tested and test results are given.

N-018
Noble, J.E.
Prepared Tin Foil For Packing Purposes
Power Plant Engineering, V. 32, p.1205, Nov. 15, 1928

A discussion of preparation of tin foil for packings for more satisfactory use. Alternate sheets of tin foil and cotton cloth coated with powdered graphite mixed with oil, rolled, and cut to length for application.

N-019 B
Nolt, T.G.
Techniques for Evaluating Gasket Loads in Flanged Joints
Machine Design, V.33, pp. 128-34, September 28, 1961

This article describes the new technique, and the three other methods, for flange design gasket selection and leakage analysis.
Solid plug compression test; gasket load from bolt torque; gasket load from bolt elongation; gasket load from washer-type force gage.

N-020
Noonan, J.W.
Materials In The Design Of Seals For Extreme Environments
Machine Design, V.34, pp. 186, 188, etc., August 16, 1962
Abstracted from SAE paper 523G, April, 1962

Study of materials for both static and dynamic seals for vacuum effects, radiation effects, and temperature extremes.
Vacuum effects: (1) evaporation or sublimation of volatile components from polymers up to 530°C;
(2) partial or complete removal of the adsorbed layer of gas which covers all materials in the atmosphere.
Fatigue life of metals is improved in vacuum especially at high stresses, sometimes poorer at low stresses than in air. Creep strength of metals is better in air at high temperature and low strain rates and better in vacuum at low temperature (1100°F) and high strain rates.
Dry film lubricants are best in a hard vacuum.
Radiation effects: results of gamma and ultraviolet radiation on elastomeric materials.
Temperature effects: fatigue and creep properties of metals at low temperatures improved. Discusses high and low temperature properties of fluoroethylene polymers.

N-021
Norbom, R.
Water Cooled Stuffing Box For Oil Pump Designed For Arc Welding
Modern Power and Eng., V.37, pp. 58-9, 80, Dec. 1943

Illustrated description of long throat, water-cooled stuffing box for hot oil pump

N-022
Normand, L.E., Rathkamp, W.R.
Evaluation of Vacuum Gasket Materials
Oak Ridge National Laboratory, 7-12 Area, Oak Ridge

The evaluation of the vacuum properties of materials attempted in the investigation reported here is restricted to the determination of the relative order of values for the outgassing rates and vapor pressures of the materials. Test operation, description, and data given. Teflon, silicone SR 1060, Mycaseal, silicone SR 1080, koroseal, Hycar OR15, neoprene, Tygon, Garlock 7986.

N-023 B
Norton, R.D.
13 Ways To Solve Packing Problems
Chemical Engineering, V.62, pp. 183-6, March, 1955

Presented are 13 ways to solve the frequent problem of shaft and packing wear on centrifugal pumps for abrasive liquids.

N-024
Norton, R.D.
Mechanical Seals For Handling Abrasive Materials
Chem. Engng., V.63, pp.199-210, Sept., 1956

Centrifugal pump problems involving abrasive materials are troublesome. Article describes mechanical seals in general and means of keeping seal faces free of solids.
Many ideas described had very limited field testing.

N-025 T
Norton, R.D.
Current Uses and Developments of Mechanical Seals for Abrasive Liquids in Centrifugal Pumps
Int. Conf. on Fluid Sealing, Paper H3 (24 pp.), April 17-19, 1961.
British Hydromechanics Research Assn., Harlow, Essex, England

When abrasives are present, it is possible to design the seal to operate either in the presence of the abrasive bearing liquid or in a clean environment. Various practical examples of both are discussed. Special attention is given to crystal formation and high-temperature operation.

N-026
Nosov, Y.A., Farberova, T.
Methods of Evaluating Rubber Used In The Manufacture of Sealing Units
Soviet Rubber Technology, V.18, No. 4, p. 36, April, 1959

The purpose of this article is to review the methods of evaluating and control-testing rubber used in the manufacture of seals. The authors note the importance of stress relaxation measurements as an index to seal material usefulness. They take care to emphasize that stress relaxation and compression set are not the same. Physical properties characterize only to a very small extent the working ability of a seal. Doubts are cast upon the method of heat aging using tensile strength as a yardstick to measure aging effects. The authors prefer ultimate elongation as a more reliable indicator. An apparatus for measuring the radial pressure exerted by O-ring seals is described. Designed at the Scientific Research Institute of the Rubber Industry, the instrument utilizes a piston holding the O-ring pushed through a thin-walled cylinder instrumented with strain gages.

N-027
Novozhilov, S.F.
Packing Devices For Gas-Turbine Regenerators
Technical Translations, Off.Tech.Serv., V.1, p. 373, June 5, 1959. #59-11280

The effectiveness of a variety of packing structures was studied to control the dispersion of air from a disk-type gyrating regenerator for gas turbine engines. Distortions in packing shapes were caused by union with the revolving rotor, high temperatures, and pressure changes. Contact-type packing work out the friction surfaces, resulting in a curvilinear shape. To prevent leakage of air, packing surfaces had antifriction and stretch properties. Leakage was further reduced with heated gas and a pneumatic accordion device (sil'fon). Experiments were conducted with various packings, including a ribbed band with triangular channels; radial, depth, and circumferential structures; a ball and roller; a piston; a contoured-hollow of the shoe; and a spring. The contoured-hollow and spring types proved most effective.

O-001
O'Donnell, J.P.
Club Told O-Rings Need Standard
Oil and Gas Journal, V. 60, pp.128-30, May 7, 1962

Proponents of O-rings applying for adoption of code. Test results of O-rings, Tables and curves. Compares pressure and stress of 2-in. ASA300 flanges equipped with O-ring and the conventional gasket. Drawings and photographs.

O-002
Okochi, M., and Ebihara, K.
Researches On The Perfect Tightness Of The Stuffing Box (In Japanese)
Soc. Mech. Engrs. of Japan, Jl., V. 31, pp. 515-9, Aug. 1928

New metallic packing for ensuring tightness of stuffing box was invented, and some properties of packing were investigated.

O-003 T
Oldroyd, J.G.
Non-Newtonian Effects In Steady Motion Of Some Idealized Elastico-Viscous Liquids
Proc. Royal Soc. of London, Series A, V. 245, pp. 278-297, 1958

Normal stress effects and the variation of apparent viscosity with rate of shear in simple types of steady flow of certain idealized elastico-viscous liquids are discussed. Normal and shear stresses are investigated as is the Weissenberg climbing effect. The behavior of these idealized liquids when sheared in a narrow gap between a rotating wide angled cone and a flat plate is compared with Roberts observations.

O-004
Opheim, M.H., and Pritchard, J.E.
Oil Resistant Rubbers From 2-Methyl 5-Vinylpyridine
Ind. Eng. Chem., V. 46, pp. 2242-5, 1954

A co-polymer is described, which shows improvement in resistance to swelling and other damage by various organic solvents and synthetic lubricants.

O-005 B
Orcutt, F.K., Bell, J.C., and others
Rotating-Shaft Helium Seal Investigation
Battelle Memorial Inst. Proj. No. 8-97-65-001C - Status Report, 44 pp., 6 Fig., 3 Tab., Aug. 1959

Second stage report of investigation concerning the sealing of Helium at 600 lbs/sq. in. Experiments to determine suitable face seal material for 3" shaft rotating at 25,000 rpm.

O-006 T
Orcutt, F.K., Bell, J.C., and others
Rotating Shaft Helium Seal
Status report on contract DA-44-009-eng. 3375- Project No. 8-97-65-001C, to U.S. Army Engineer Research and Development Laboratories, Aug. 25, 1959, Supp. Rept., Nov. 9, 1959

Evaluation and study of positive rotating shaft seals for application to high speed turbo machinery using high pressure high temperature helium as working fluid. Target specifications: Turbine speed 25,000 rpm, with helium at inlet 1000 psi and 1350 F, seal life 5000 hours.

O-007 B
Osola, V.J.
Some Experiences In The Application Of Mechanical Seals To Pumps And Stirred Pressure Vessels
Chem. Engr., 152, pp. A41-53 (Incorporated in Trans. I. Chem. Engrs., V. 38, December 1960

Description of the general operating principles of mechanical seals used in water circulating pump, a process pump and overhanging shaft.
The sealing of various designs of pressure vessels, capacities up to 600 gallons, 100°C temperature, to 250 lbs/sq. in. pressure.

O-008
Ossefort, Z.T.
Evaluation Of Polymers For Use As Ammunition Box Gaskets
U.S. Arsenal, Rock Island, Ill., 33 pp., photos, graph, tables, July 1952, PB 115301 - Lib. Cong. Publication Board Project - Wash. 25, D.C.

Project No. TB4-521C Report No. 2
1. Gaskets, Synthetic Rubber-Test
2. Boxes - Gaskets
3. Rubber-Synthetic Test
4. R1A6 R52-1972.

O-009
Osten, D. von den
Packing Ring
L.C. or SLA - 60-13286 (Trans. of Swedish pat. 111,729, C147F22-11, 9 May 1942)

A packing ring, designed for packing parts which are exposed to high temperatures, is described which consists of a sheet metal jacket and a mineral filling substance. The filling substance is composed of a fine powder of a substance pressed into the jacket which, in the vicinity of the operating temperature, through physical or chemical change, experiences an extra increase in volume which is greater than that which corresponds to the simple expansion by heating. The filling substance consists of talcum.

P-001
Page, R.L.
Testing Of O-Ring Seals For Reactor Pressure Circuits
GEC Atomic Energy Rev., V. 2, pp. 210-215, Autumn, 1960

Statis seals of silicone rubber are satisfactory for sealing carbon dioxide to 150°C and 150 psig. Any loss of carbon dioxide is due to diffusion through the silicon rubber rather than to leakage.

P-002 T
Pai, S.I.
On Turbulent Flow Between Parallel Plates
ASME Trans., V. 74, pp. 109-11, 1953

Reynolds' equations of motion are derived and solved for two special cases, Poiseuille flow, and Couette flow. The mean velocity distribution and the correlation u/uz (turbulent velocity fluctuations) can be expressed in a form of polynomial of the coordinate in the direction perpendicular to the plates, with the ratio of shearing stress on the plate to corresponding laminar flow of the same maximum velocity as a parameter. These expressions hold true all the way across the plate, i.e. both turbulent region and viscous layer including the laminar sublayer. It also shows that the logarithmic mean velocity distribution is not a rigorous solution of Reynolds' equations.

P-003
Pall, D.B.
Development Of Filters For 400°F And 600°F Aircraft Hydraulic Systems
Library of Congress, PB 128057 ($7.80/photostat copy) May 1956

Report on development of ten micron hydraulic oil filters operating in the range from -65°F to +600°F. Housings of aluminum construction and suitable seals were developed for range -65°F to 400°F. Steel construction -65°F to +600°F service.

P-004
Palmer, A.B.
Pressure Regulator Seals
Missile Des. & Devel., pp. 38, 50, April 1959

Development, requirements, and operation of pressure regulator seals.

P-005
Palsulich, J., and Piedel, R.E.
Dynamic Seals For Aircraft Gas Turbine Engines
SAE Paper No. 685, Jan. 9-13, 1956

Problems encountered in sealing various media in main shaft and accessory drive applications; major types of seals; sealing problems grouped into three categories; main shaft bearing lubrication systems, containing or controlling air flow within proper channels, sealing accessory drives.

P-006
Panek, J.R.
Elastomeric Joint Sealants
A.S.M.E. Paper No. 62-WA-328, 4 pp., Oct. 1962

The author discusses the need for sealants, types of sealants, recommended uses for sealants, recommended sealing practices, and specifications for elastomeric joint sealants. Thiokol polysulfide liquid polymer.
Urethane sealants
Silicone sealants
Chlorosulfanated polyethylene sealants
Acrylic-acid base sealants
Tests procedures.

P-007
Paree, D.
Illustrated Description Of Utilization Of Felt In Connection With Ball Bearings In Order To Prevent Oil From Leaking (In French)
Annales des Travaux Publics de Belgique, V. 46, pp. 536-40, Aug. 1945

(None given)

P-008
Parker, E.J.
How O-Rings Seal Air And Oil Components
Applied Hydraulics, V. 10, pp. 121-124, May 1957

This paper covers the theory, advantages and limitations of O-rings together with certain application problems: surface, temperature, contamination, etc. O-rings have been used up to 50,000 psi.
A glossary of O-ring terms is included.

P-009
Parker, E.J.
How To Design For O-Ring Seals
Applied Hydraulics, V. 10, pp. 84-87, 134-135, June 1957

Most published data for O-rings follows accepted aircraft standards based on satisfactory sealing at -65°F and using breathing cylinders. This imposes cost penalties on equipment without these same operational requirements.
This article provides details of gland design to assure proper sealing action on specified jobs.

P-010
Parker, E.J.
Prevent O-Ring Failure
Applied Hydraulics, V. 10, pp. 152-154, 156-158, Oct. 1957

O-rings may be used for many and varied applications as hundreds of O-ring compounds are manufactured to handle specific service environments.
A chart of 19 such compounds, their major uses as O-rings and their temp. range is covered.
Possible reasons for failure are also included.

P-011 B
Parker, S.M.
Seals
Chapter 1 of Book "Aircraft Hydraulics, V. II - Components Design," pp. 1-19, Conway, H. (Ed.)
Publ. by Chapman & Hall, 1957

P-012
Parrish, W.A.
Synthetics Hold Aromatic Fuels
Aero. Digest, V. 52, pp. 62, 155, Feb. 1946

Gaskets and seals made of plastics exhibit resistance to oil and aviation gasoline.

P-013
Parsons, C.A.
Labyrinth Packings
Engrg., Jan. 10, 1908

Describes a packing adopted by C.A. Parsons to diminish leakage losses in his steam turbine, and gives formula for calculating the discharge through the packing.

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P-014
Pate, M.T.
Reducing Leaks In Pipeline Flanges
Power, V. 82, p. 113, February 1938

Flanges on 8 inch main line. Normal working pressure of 675 lbs. per sq. in. produced a total endwise load on flange bolts of 19,000 lbs.-29,000 lbs. As a result of investigation, metallic gaskets and joint rings were removed from all points subjected to pulsating pressures, and replaced with plastic materials. A further improvement was made by cutting the inside diameter of gasket material from 1/8 to 1/4 in. smaller than the inside diameter of the flanges.

P-015
Paterson, M.S.
O-Ring Piston Seals For High Pressure
Journal Scientific Instruments, V. 39, No. 4, pp. 173-4, April 1962

Describes three types of piston seals, and gives advantages of each. Discusses several other types. Drawings included.
O-ring seals; 10,000 atmospheres pressure, bevel rings of bronze and beryllium copper.

P-016
Paxton, R.R., Shobert, W.R.
Testing Carbon For Seals And Bearings
Lubrication Engineering, V. 17, pp. 27-33, Jan. 1961

A test method which has been of practical value in screening carbon-graphite materials for seals and bearings is described. Details of relatively simple tests are given. Typical experimental data are presented illustrating the use of this test stand to obtain performance data on one carbon base material running non-lubricated.

P-017
Payne, F.E.
Roll Neck Seals - Their Development And Application
Steel, V. 123, pp. 92, 94, 98, 102, Nov. 29, 1948

Steel mill roll bearing sealing problems increased with advent of high speed mills. Early attempts at solution included conventional stuffing boxes, piston rings, lip seals (single and double) and finally vertical plane and face seal or the "John Crane" roll neck seal, described in text.
Materials included felt, flax, semi-metallic packings, treated leathers, etc.

P-018
Payne, G.F.
Rubber And Asbestos In Engineers Jointings And Packings
Chem. Age (Lond.), V. 38, pp. 63-4, Jan. 22, 1938

P-019
Pearl, D.R.
O-Ring Seals In The Design Of Hydraulic Mechanisms
Mach. Design, V. 19, pp. 97-102, May 1947

Practical information on their design, characteristics, and application in hydraulic mechanisms is given as are special uses.

P-020 T
Pearl, D.R.
O-Ring Seals In Design Of Hydraulic Mechanisms
Trans. SAE, V. 1, No. 4, pp. 602-611, Oct. 1947

A thorough work on O-ring seals covering characteristics, theoretical aspects, moving O-ring seals, rotary shaft seals, types of seal failures, design procedures. Sketches and data curves included.

P-021 T
Pearson, J.D.
Turbine Glands
Trans. Inst. Marine Engrs., V. 44, Part 5, pp. 219-223, 1932

A review of the water filled gland seal and the labyrinth seal. The discussion of the labyrinth seal is basically that due to Stodola, and a number of seal geometries presently used in steam turbines are shown.

P-022
Pennington, J.W., and others
High Speed - High Temperature Shaft Seals
SAE Paper No. 687, p. 12, Jan. 9-13, 1956

Problem of selecting and designing fluid flow barriers against rotating shafts in gas turbines; basic designs of several seal types discussed have provided sealing ability required in most turbine applications.

P-023
Perry, J.H.
Choosing Gaskets For Use In Chemical Plants
Chem. & Met. Engng., V. 41, pp. 194-198, April 1934

The importance of the gasket in a flanged joint, unit pressure and the bolt load; twenty commonly used types of formed and sized commercial gaskets; proper application and installation of gaskets.

P-024
Perry, J.T.
Mechanically Sealed Beryllium Windows For Permanently Evacuated X-Ray Tubes
Review of Scientific Instruments, V. 27, pp. 759-762, Sept. 1956

In the tubes described, the Beryllium window, which may be as thin as 0.25 mm., is clamped with a soft metal gasket to a steel window frame. The frame is actually a flange, copper-brazed to a nickel-iron sleeve which is sealed to the side of the glass envelope of the tube, and the window and gasket are clamped down by a second steel flange with 12 fixing screws. Some data are presented on the performance of the tube.

P-025 T
Peters, A., and Sciulli, E.B.
A Bibliography On Gas-Lubricated Bearings
The Franklin Institute Laboratories, Interim Report I-A-2049-16, Oct., 1961, OTS No. AD 264965

The results of an extensive survey was part of a government sponsored program of research on gas-lubricated bearings. The survey included all available references, many foreign, on the subject of gas-lubricated bearings.

P-026 T
Peters, C.W.
Word About Turbine Packing
Power Plant Engineering, V. 39, pp. 586-7, Oct. 1935

A brief descriptive article of a shaft packing failure of a steam turbine generator which almost threw a unit from its base.

P-027
Peters, J. L.
Mass Spectrometer Tests Tightness Of Seals
Electronics, V. 33, pp. 74-76, April 1, 1960

Production-line leak-detecting mass spectrometer is usable in electron tube manufacturing. Unit achieves high precision with two magnetic analyzers in series. It determines leak size by measuring quantity of helium escaping. Description of equipment, operation, performance and industrial use. Drawings, curves, and data.

P-028
Peters, R. L.
Lubrication Of Rocket Engine Pumps Utilizing High Energy Propellants
Sci. Lub., V. 14, pp. 26-29, April 1962

General problems pertinent to the design of a hydrogen pump are initially discussed. Specific oxidizer problems as presented in design of a hydrogen pump are next discussed and finally the fluorine pump problem is treated. Seal isolation in the fluorine pump is accomplished by use of a secondary oxidizer which provides a barrier between the fluorine (extremely corrosive) and the seal.

P-029
Peters, V.
Notes On Hydraulic Packings And Stuffing-Box Design
Iron Age, Dec. 15, 1904

Describes several constructions of hydraulic cylinder and plunger packings and their practical applications, and gives hints for selecting and designing satisfactory packings for parts moving under hydraulic pressure.

P-030
Petersen, A. B.
Development Tests Of Pneumatic Equilibrators With Experimental Neoprene Packings (O Type) For 155MM Carriage Ml, 2nd Report; 37th Report On Ord. Pro. 5084
PB 33949, Off. Tech. Sev., 76 pp., Jan. 1945

The results of tests to determine if the experimental "A" type neoprene packings are suitable and satisfactory for the prevention of nitrogen leakage, and whether they are sufficiently superior to its "T" type neoprene packing to warrant adoption as a standard in the pneumatic equilibrators, are contained herein. It was found that nitrogen and oil seal leakage were not prevented. Photographs, drawings, and tabulated test results are presented.

P-031
Peterson, L. M.
Sealing Rings From German Engine
PB 2943 - Off. Tech. Sev., 3 pp., 1945, (Army Air Forces, Eng. Div., T.S.E.P.L. 5-503-3080)

Memorandum report on the physical and chemical properties of synthetic rubber cylinder sleeve sealing rings from Junker Juno 213 aircraft engine.

P-032
Petrie, E.C.
Ring Joint; Its Relative Merit And Application
Heating and Piping, V. 9, pp. 213-220, April 1937

Data on bolt, gasket, and pressure are presented in connection with the application of the ring joint to high pressure and high temperature service.

General characteristics of ring joint connection.
Effective pressure area of ring joints.
Results of comparative tests of ring and flag gasket joints.
Determining width of ring sections for ring joints.
Application of ring joints.
Data and Photographs.

P-033
Pfefferle, G.H.
Distribution Of Gasket Pressures In Pipe Joints And Clamps
Gas Age, V. 73, pp. 379-82, 386-8 +, April 21, 1934

P-034
Pheil, G.D.
Air Curtain Shaft Seal
Prod. Engng., V. 31, p. 24, Dec. 26, 1960

An "air curtain" shaft seal similar to those used to keep cold air out of doorless supermarkets and public buildings is proposed. Air would be pumped through the center of the shaft and out of a grid or porous bronze section, in the shaft. It would provide an effective seal between enclosed areas of different temperature, pressure or humidity and would not have to be lubricated or replaced because of wear. At high rpm, radial holes could be angles so that centrifugal force would automatically pump the air and contribute to the effectiveness of the seal.

P-035
Phillips, M.J.
Design Of Piston Type Accumulator Uses Positive Type Pressurized "O" Seals
App. Hydraulics, V. 4, pp. 26-27, Feb. 1951

A simple design provides a well lubricated seal with a higher sealing pressure than the existing pressures on both the gas and oil sides of the piston.

P-036
Pieckii, V.L., and Christensen, D.A.
How To Choose A Dynamic Seal
Product Engineering, V. 32, pp. 57-68, March 20, 1961

Describes and shows operation of 5 basic types: shaft seals, face seals, compression packing, molded packings, and labyrinth or positive-clearance seals. Analyzes each type for basic selection factors, materials, and design recommendations.

P-037
Pieckii, V.L.
Selection Factors For Radial-Type Oil Seals
Machine Design, V. 34, pp. 264, 266, 268, 270, April 26, 1962, Abstract from SAE Paper 473B, Jan. 1962, 13 pp., "Oil Seal Performance: a Key to Reliability," see also SAE Journ., V. 70, June 1962, pp. 57-63

Selection factors for dynamic elastomer seals for sealing in lubricants. Factors are seal materials and section shapes. Effect of various cross-sectional shapes for sealing elements is discussed.
Material considerations for increasing seal life:
1. Choice of elastomer. This is determined by type of lubricant and mean temperature.
2. Curing agent used in vulcanization of elastomer.
3. Reinforcing agent for elastomer to improve abrasion resistance, dynamic stability and moldability.
4. Additives to lubricants, especially antioxidants and detergents.

P-038 B
Pillai, G.
Elastomers For Hydraulic Packings
Hydraulics and Pneumatic, V. 14, pp. 80, 82-3, March 1961

Reviews the manufacturing processes, compounding moulding and finishing of elastomeric materials. Attention is drawn to the importance of seal fluid compatibility with water, polyglycols, organic phosphates, silicones, chlorinated hydrocarbons and petroleum hydrocarbons.

P-039 B
Pillsbury, R.D.
Plastic Piston Rings
Machine Design, V. 33, pp. 147-9, September 28, 1961

Use a seal material capable of operating without lubrication to solve the problem of product contamination from lubricants used in reciprocating sealing devices.
Configurations, Material properties - Piston design.

P-040
Pirani, M., Yarwood, J.
Principles Of Vacuum Engineering
Reinhold Publishing Co., N.Y., 1961

Vacuum Plumbing: Seals and Sealing Chapter 4, pp. 146-213. Demountable Seals:
4.15 Vacuum Greases
4.16 Elastomer Seals
4.17 Rubber Gaskets and O-rings
4.18 Vacuum Pipe Connectors
4.19 End Seal Plates
4.20 Lead in Seals
4.21 Rotary Vacuum Seals
4.22 Rectangular Rubber Gaskets
4.23 Gaskets Supported by Metal Inserts
4.24 The Wilson Seal & the Gaco Seal
4.25 Silicone Rubber Gaskets
4.26 Teflon Gaskets
4.27 Metal Gaskets

P-041
Platt, H.
You Can Pack Centrifugal Pumps To Hold High Pressure And Temperature
Power, V. 88, pp. 8-10, 62a., Jan. 1944

Paper explains methods and materials used to pack centrifugal pumps for subject conditions. Materials are braided cotton, braided asbestos, molded plastic asbestos with rubber or neoprene binder, lead foil with asbestos core, aluminum, copper or phosphor-bronze foil. For high pressure or high temperature control of stuffing box, a sealing liquid is circulated through lantern rings to absorb heat and provide lubrication of the packing.

P-042 T
Ploeger, C.E.
Compressor Shaft Seal
U.S. Patent 2,290,813 July 21, 1942

A mechanical seal design which is self-aligning and which can be easily demounted for replacement or repair.

P-043 B
Plutalova, L.A.
Graphite Seals For Rotating Shafts
Vestnik Mashin (U.S.S.R.) 2, pp. 3-8, 1957 (In Russian) (United Kingdom-Atomic Energy Authority translation No. LB Information series 64(RD/R) 1959, also LC or SLA No. 61-13618

Russian progress in the field of split face seals with apparent success with pressures up to 150 lb/sq. in. Shaft diameters 4 and 6 cm and speeds between 600 and 3000 rpm were used during experimental work.

P-044
Pohl, E.
Damages To Steam Turbine Stuffing Boxes (In German)
Maschinenschaden, V. 15, pp. 117-123, 1938

Illustrated account of various instances of failures of labyrinth packings.

P-045
Pohl, E.
Operating Experiences With Packings And Equalizing Discs Of The Ljungstrom Turbine
Maschinenschaden, V. 17, pp. 81-86, 1940

Economical and safe operation of the Ljungström turbine depends to a considerable extent on the ability of the packings to stand up under various service conditions. Paper discusses the design of the elements in the packings and equalizing discs, and the various causes of mechanical wear and corrosion.

P-046 B
Pollard, F.H.
The Development Of High Temperature Hydraulic Systems For Aircraft
Proc. 13th National Conference Industrial Hydraulics, V. 11, pp. 57-65, 1957

Considers temperature categories, packing development, back up rings, and static seals. Test results on Buna N, Neoprene, acrylics, and Viton A. (Vinylidene Fluoride Hexafluoropropylene Copolymer) temperatures -65 to 500°F. Pressures to 3000 psi.

P-047
Pollard, F.H.
Design Tips For Using Viton
SAE Jour., V. 67, pp. 80-81, May 1959, Abstract of SAE Paper 50R, "Designing for use of Viton O-rings at elevated temperatures," from meeting of March 31, 1959, 10 pp.

Dupont Viton A, vinylidene fluoride hexafluoropropylene copolymer, has a usable thermal range of -65 to 600F. Its characteristics of hardness, mold shrinkage, fluid effects and extrusion gap are assessed for O-rings for seals in hydraulic cylinders and other components of supersonic aircraft.

P-048 T
Popper, B., Reiner, M.
The Application Of The Centripetal Effect In Air To The Design Of A Pump
British Jnl. App. Physics, V. 7, pp. 452-3, Dec. 1956, (correction) V. 8, pp. 493-4, Dec. 1957

The authors describe a device to make use of the centripetal effect in air in an air pump.

P-049 B
Porges, F.B.
Mechanical Seals In The Petroleum Industry
Proc. 3rd World Petrol. Conf. (The Hague), pp. 222-35, 1951

After discussing the principle of this type seal, the author illustrates and describes in detail several leading contemporary designs and compares them. Description of two cases in which a face seal became more economical than a stuffing box in spite of its high initial cost.

P-050 T

Postler, J.W.
Pressure Compensating Seal
Chemical Engineering, V. 54, pp. 118-19, June 1947

Suggest the use of a double mechanical face seal for higher pressures, where a pressure of half the sealed pressure is introduced between the seals.

P-051 T

Pratt, W.E.
Selection Of Pumps For Chemical Service
Ind. and Eng. Chemistry, V. 31, No. 4, pp. 408-15, April 1939

A general discussion of the importance of pump selection procedure, special attention to material and alloy of component parts. Seal commentary limited to stuffing box with water as a lubricant.

P-052

Pratt, W.E.
Unusual Stuffing Box Problems Encountered In Acid Pumping
Chem. and Met. Eng., V. 50, pp. 109-13, April 1943

The main concern of this article is to analyze some of the troubles that occur on certain acid pump installations where all operating conditions appear to be favorable, and yet recurrent serious difficulty persists. Illustrations of shaft seals.

P-053

Pratt, W.E.
How Carbon Rings Saved $114 Per Year In A Troublesome Centrifugal Pump Problem
Chem. and Met. Eng., V. 52, pp. 116-17, July 1945

Pumping hot acid with abrasive solids in suspension is a severe service. The problem was to bring about a condition which would prevent any contact between the bottom rings of packing and the shaft shroud, which was an integral part of the impeller. This could be accomplished by the use of packing rings in which the solid abrasive particles could not imbed themselves. Details of a case in point and its solution. Photographs included.

P-054 T

Primeau, G.H
Seal
U.S. Patent 2,977,139 March 28, 1961

Seal for automatic transmissions. A tetrafluoroethylene sealing member is maintained in sealing engagement with a rotating surface by a garter spring. The sealing member is held stationary by a two-coil helix retaining ring.

P-055

Provaznik, F.
Gas Seal Of Hydrogen-Cooled Electric Machines
Elektrotech, Obzor, 44, No. 5, 221-4, 1955 (In Czech).

The tightness of the gas seals of hydrogen-cooled electric machines is investigated quantitatively by a method based on the Van der Waals' equation. The permeability of the seal, expressed in M^3 gas escaped during 24 hours, is determined from the initial and final parameters of the gas compressed in the seal to about 1-2 atm. above gage pressure. The effect of the kind of gas and its pressure are also investigated.

P-056

Puchstein, A.F.
Sealing Components For Shafts And Bearings
Elec. Mfg., V. 31, pp. 106, 108, 110 etc., March 1943

Reviews types of seals suitable for the sealing of rods, shafts and bearings.
Materials: fibrous, leathers, natural and synthetic rubbers, cork, plastic, asbestos, carbon, graphite, metallic, etc.
Materials suitable to hold or exclude low medium or high pressure at low medium or high temperatures up to 1500°F. Compatible with a variety of materials v.g. oils, gasoline, acids, etc.
A variety of seal types are discussed, labyrinth, cup, piston, rings, etc.

P-057

Purdy, R.B.
Get The Most Out Of Your Packing
Power, V. 77, pp. 624-5, Dec. 1933

Proper packings to use; what causes a packing to leak; how to install a packing on pump or engine rod.

P-058

Purves, T., Jr.
Packing For Piston Rods And Valve Stems
Ry. Review - 1200, May 16, 1896

A review of a paper before the New England Railroad Club. The conclusions are favorable to metallic packings in preference to hemp, and some figures of maintenance cost are given.

P-059 T

Quinn, N.R.L.
Sealing Device
U.S. Patent 2,814,512 Nov. 26, 1957

In a thin shaft seal, which is related to the face seal, the rotating seal surface is a radial surface perpendicular to the shaft. The stationary seal ring then forms a converging passage in direction of pressure decrease. The result of the passage configuration is a force tending to open the gap. With this device, by regulation of the intermediate pressure, any desired normal operating gap may be maintained.

R-014 T

Rankin, D.R.
Gives Mechanical Seals A Chance
Chemical Eng., V. 59, pp. 152-3, January, 1952

Lists the advantages and limitations of mechanical seals. Temperature and pressure ranges presently sealable are given. Also an explanation of the difference between balanced and unbalanced seals.

R-015

Rasmussen, R.
Method of Sealing Flared Tube Fitting Used With Permeative Fluids
Parker Appliance Co., pp. 1-4, March 21, 1957

To compare the performance of Teflon-coated fitting noses to standard machined noses.

R-016

Ratner, A.V. and Zelenskii, V.G.
Erosion of Seals in Water and Steam Fittings
Teploenergetika, No.12, pp. 28-32, 1957.
Main Library Translation TF-4755, General Electric Co.

Data are given on the erosion of various metals by water and superheated steam. Temperature 480°C. at a velocity of 150 m/sec.

R-017

Ratner, A.V., Kagan, D. Ya.
Investigating Corrosive Action in Packings
Trans. of Teploenergetika, USSR, V. 8, No. 5, pp. 35-39, 1961
(Translation No. FT612, available from Faraday Translations, New York, N.Y., $11.75 ea.)

Description of gaskets, hydraulic seals, pneumatic packing, corrosion research.

R-018

Raymond, E.T., and Hull, J.W.
Aircraft Reliability Demands Leakproof Hydraulics
Applied Hydraulics and Pneumatics, V. 11, pp. 74-77, Oct., 1958

In designing aircraft hydraulic systems for high reliability, the prevention of fluid leakage is one of the most important factors.
Minimizing the number of leakage points is one of the principal steps in designing a leakproof system. Elastomeric O-rings are still considered best for most seal applications, although metal seals are contemplated for future aircraft and missile applications.
Bellows-faced seals are used for many applications. Two-stage seals improve reliability when applied to O-ring and metal seal configurations and used in conjunction with a pressure drop bushing.
Ring seal tolerates angular misalignment between the rod and seal gland. The choke seal designed for low friction has worked very satisfactorily in laboratory tests. Both are metal seals and show significant advantages over elastomeric O-rings.

R-019 T

Raymond, E.T.
High Temperature Hydraulic Seal Developments for Future Flight Vehicles
Int. Conf. on Fluid Sealing, Paper G1 (26 pp.), April 17-19, 1961
British Hydromechanics Research Assn., Harlow, Essex, England

Problems involving static and dynamic seals due to high temperatures encountered in high-speed flight are discussed. Promising high-temperature sealing methods are discussed.

R-020

Reeder, A.
Hydraulic Packings
Am. Mach., V. 29, pp. 322-323, Sept. 6, 1906

Illustrated examples of packings and types of connections, giving explanations.

R-021 T

Reiner, M.
The Centripetal-Pump Effect in Air
Proc.Royal Soc. of London, Series A, V.240, pp. 173-188, 1957

An instrumental arrangement is described which constitutes a centripetal air pump. It can be seen that air is pumped from the outer atmosphere into the pump cylinder. Air is in a state of stress including elastic cross stresses. Definition in Hencky's logarithmic measure. Confirms Maxwell's theory that air is elastoviscous. A rheological equation for air is proposed.

R-022 T

Reiner, M.
The Centripetal-Pump Effect in a Vacuum Pump
Proc.Royal Soc. of London, Series A, V.247, pp. 152-167, 1958

An instrument is described which works as a centripetal vacuum pump. The rotor can be freely displaced along its axis of rotation. By centripetal pumping action it is kept floating on an air cushion of thickness "D". The relation between "D" and speed of rotation was determined for different rotor weights supported. The results are interpreted on the basis of Maxwell's theory of the elastoviscosity of air.

R-023 T

Reissenger, H.
Two and Three-Dimensional Flow of Viscous Incompressible Fluids, Without Inertia, Between Relative Rotating Eccentric Cylindrical Surfaces (In German)
Zeit. für Angew. Math. und Mech., Report I, V. 15, pp. 81-87, 1935;
Report II, V. 16, pp.275-286, 384, 1936

The author derives a general equation for pressure function and flow function in the annuli, which he solves for the case of a narrow annulus. For evaluating bearing load force and frictional moment, the basic stress relationships according to Stokes are presented. Report I, two-dimensional flow. Report II, three-dimensional flow.

R-024

Resek, R.B.
Hydraulic Actuator Rod Seal for High Temperature Operation
PB 135219, Off.Tech.Serv., USAF-WADC-TR-56-268

A rod seal was required for hydraulic actuators which would operate with fluid and ambient temperature as high as 700°F. A test actuator and test stand were designed and built for testing sample seals from -65°F to 400°F. Both static and cycling tests were run with metallic seals, tubular metal seals, and several types of asbestos seals.

R-001
Rabinow, J.
Developing Seals For Abrasive Mixtures
Mach. Design, V.23, pp. 128-131, June, 1951

Describes problems attendant to the development of a shaft seal for a magnetic-fluid clutch.
Various types of seals were tested, such as standard rubber packing, O-rings, felt seals, and special Teflon seals, but none were successful.
A successful seal was finally designed based on a well-known magnetic separator principle. Rubber seal rings were used in this seal.

R-002
Rademaekers, W.A.
Seal-Ups Fitting Reliability
Aircraft and Missiles, V.4, pp. 42-4, Feb., 1961

Description of a double seal-type fitting for aircraft and missile fluid systems. The new fitting gives reliability at high temperatures and pressure. Factors affecting design of such fitting are discussed briefly.

R-003
Raether, H.
Note on "Simmer Rings," Vacuum-Proof Packings, Used in Laboratories for Actuating Movements Within Vacuum Apparatus (In German)
Zeit.für Technische Physik, V.23, pp. 266-6, 1942

Sealing arrangement consists of cylindrical jacket and internal sleeve, both of rubber-like material called "Simrit"; jacket is stiffened with metal ring; sealing of sleeves is effected with an aid of "packing lip" likewise of "Simrit;" because of its flexibility, this lip clings to spindle and prevents air leakage.

R-004 T
Rainey, R.S.
Recent Developments in Fluid Sealing
Automotive Industries, V.100, pp.233-4, March 15, 1949

Description of new improvements in standard leather and rubber lip-type shaft seals, which could be used in many instances where more expensive sealing methods are now used.

R-005
Rainey, R.S.
Engineering Oil Seals to the Product
Tool Engr., V.23, pp. 29-31, Oct., 1949

Relative values of leather and synthetic rubbers as oil seals are discussed. Application norms are given. Maximum temperature considered 300°F.

R-006
Rainey, R.S.
Which Shaft Seal?
Prod. Engng., V.21, pp. 142-147, May, 1950

Tabulates the characteristics of the various types of seals such as springless, spring-loaded, dual, and face. Materials: leather, rubber, synthetics. Application problems are discussed.

R-007
Raisbeck, L.R.
Investigation of Hydropneumatic Recoil Mechanism Packing Spring Loads
PB 174730, Off. Tech. Serv.

Conventional packings for Howitzer Hydropneumatic Recoil Mechanism floating pistons were treated to determine the relationship between axial packing load and radial packing pressure at sub-zero, normal, and elevated temperature. Tests were conducted with leather - silver - rubber and Teflon-aluminum-rubber packings. Both types were tested in a 105 mm Howitzer Hydropneumatic Recoil Mechanism to determine their sealing effectiveness.

R-008 B
Ramadanoff, D. and Sherlock, J.J.
Mechanical Carbon Graphite: A Unique Material for Rubbing Surface Applications
A.S.L.E. Paper 61 AM, 1B-2 (7 pp., 1 fig.), April, 1961

R-009
Rand, W.M., Jr.
New Flowed-In Gaskets
Materials and Methods, V. 37, pp. 78-79, Jan., 1953

Called the "flowed-in" gasket, it is applied as a liquid synthetic rubber or resin compound forced through a nozzle onto a spinning component part and then baked to form a solid rubbery gasket.

R-010
Rand, W.M., Jr.
Mechanical Applications of Flowed-In Gaskets
Mechanical Engineering, V.75, pp. 541-544, July, 1953

Describes applicable materials and uses. Diagrams.

R-011
Rand, W.M., Jr.
The Latest Development in Flowed-In Gaskets
Product Engng., Annual Handbook, pp. J.30-J.31, 1954

New flowed-in gaskets produced by pouring liquid gasket material into place, and baking the compounds to solid films, are described.
Requirements of material and equipment covered.

R-012
Rankin, D.R.
Using Mechanical Seals for Centrifugal Process Pumps
Heat, Piping and Air Cond., V.23, pp.102-105, Oct., 1951
Petroleum Engng., V.23, p. C.13+, Sept., 1951

Discusses in some detail the application of pump seals, and gives practical advice on their proper use in industrial processes. Seals are limited to temperatures below 250°F with standard materials and 450°F with special ones. Operating norms for balanced and unbalanced seals are listed.

R-013
Rankin, D.R.
Why, When, Where to Use Mechanical Seals for Centrifugal Process Pumps
Industry and Power, V. 61, pp. 76-78, 117, Dec., 1951

Surveys the problems and characteristics of the above. Illustrations and diagrams.

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R-025
Reuss, H.
Problem of Sealing of Ships Shafts (In German)
Werft-Reederei-Hafen, V.22, pp. 273-5, Sept.15, 1941

Selection of seals in relation to type of bearings; illustrated description of various types of seals which result in considerable savings in costs and valuable metals.

R-026
Reynolds, F.L.
Use of Indium in High-Vacuum Equipment
Atomic Energy Commission Report V.C.R.L. 2989, May, 1955

Three methods of using indium for gaskets are described: 1) indium wire, 0.050" diameter, is placed in a groove between the flanged joints to be joined; 2) indium is soldered to the flange surfaces and pressure sealed, 3) indium is coated onto a copper ring gasket and a knife edge structure is employed for the metal-to-metal contact.

R-027 B
Rheingans, W.J.
Recent Developments in Francis Turbines
A.S.M.E. Paper 51-A-101 (15 pp., 15 fig.), Nov., 1951
Mech. Engng., V.74, No.3, pp. 189-96, March, 1952
Disc. Mech. Engng., V.74, No.6, pp.510-2

A carbon ring seal is illustrated which can replace the stuffing box used in the past. Advantages are indicated.

R-028 T
Rhodes, A.F., Eichenberg, R.
Pressure-Energized High Pressure Gaskets
Int.Conf.on Fluid Sealing, Paper B4 (16 pp.), April 17-19, 1961
British Hydromechanics Research Assn., Harlow, Essex, England

Describes the pressure-energized gasket design arising from further development of the AWHEN-AP1 gasket and flange design previously presented to the American Society of Mechanical Engineers in ASME Paper 57-DET-23, by Robert Eichenberg.

R-029
Rice, C.W.
Liquid Film Seal for Hydrogen-Cooled Machines
General Electric Review, V.30, pp.516-530, Nov., 1927

The type of seal studied by the author consists, in its rudimentary form, of a metal ring surrounding the shaft with a small clearance between them; a groove is turned in the median plane of the ring which is provided with an opening through which oil under pressure is forced into the groove. It flows axially through the annular clearance spaces on each side of the groove, one toward the hydrogen and one toward the air. Data, drawings, and test results.

R-030 T
Rice, C.W., Snell, D.S.
Liquid Film Seal
U.S. Patent 2,236,274, March 25, 1941

A shaft seal on a gas-cooled machine which utilizes the bearing as part of the seal. Lubricant and identical sealing fluid are pumped under pressure higher than gas pressure to annular chamber formed between the bearing and an additional bushing. The sealing fluid which contacts the sealed gas is drained off separately.

R-031
Richards, A.E.
Packing
Modern Power & Eng., V.44, pp.79-80, Dec., 1950

Packing defined as material used to lessen or prevent leakage of fluid or gases between moving parts; suggestions regarding selection of packing to fit particular process and equipment; problems of high-speed packings; packing pointers.

R-032
Richards, C.B., Smith, J.R.W.
Demountable Vacuum Seal
Journal Scientific Instruments, V.31, pp.431-2, Nov., 1954

Drawing of the simplest version of the seal as used to close the end of a glass tube. Basically, it consists of a metal plate and retaining ring holding an O-ring, the section of which is constrained on three sides by the metal and presents the fourth side to the square cut, flame polished end of the tube. The force exerted on the plate by the pressure of the atmosphere is sufficient to compress the O-ring against its constraining surfaces and make the seal vacuum tight.

R-033
Riddle, J. and Durrett, R.D.
Face Type Rotating Shaft Seals
Mill and Factory, V.63, pp.87-90, Sept., 1958

Mechanical axial seals are divided into two types, depending on whether the spring-loaded seal ring is stationary or rotary.
The most common applications of both types are discussed, together with their advantages and disadvantages.
A fluid compatibility chart of several elastomers is included.

R-034 T
Riesing, E.F., Klein, H.H.
Radial Shaft Seals
Mechanical Engng., V.73, pp.820-1, Oct., 1951

Commentary on unitized radial contact shaft seals operating on shafts or in boxes, rotating from 1 rpm to 10,000 rpm. Peripheral speeds from less than 1 fpm to 5000 fpm; temp. -60°F to 400°F; 300 psi to negative 14 psi.

R-035
Riley, M.W.
Treated Felts
Materials and Methods, V.44, No.6, pp. 90-93, Dec., 1956

Description of felt treatments consisting of chemical modification, impregnation, lamination, surface coating and combinations of these treatments; their use to change basic physical properties of felt; to protect felt; or improve forming characteristics and simplify fabrication.

R-036
Robbins, C.G.
Metallic Packings
Power, N.Y., V. 22, pp.15-24, 39 fig. April, 1902

Descriptions are given of the principal packings now in use in the United States. 15 different designs.
United States Metallic Packing: babbitt, bronze, metal rings
Swain metallic packing, spring loaded and inclined surfaces
Jerome metallic packing, spring loaded, cast iron
France metallic packing, spring loaded on outer circumference
Walker metallic packing, encircling springs
Paragon metallic packing
Harthaus metallic packing
Deeds metallic packing, 4 blocks, antifriction, beveled joints
Holmes metallic packing
Katzenstein metallic packing
Faultless metallic packing
Tripp metallic packing
Sterling metallic packing
Donning metallic packing
Udstad metallic packing

R-037
Robbins, C.G.
Observations on Metallic Packings
Marine Engng., V.7, pp.337-9, July, 1902

A comparative study of the theories of fibrous and metallic packings and the reasons for the efficiency of the latter. Ill.

R-038
Roberts, F.
Increasing the Efficiency of Piston Rod and Throttle Packing
Railway Mech. Eng., V.95, p. 520, Aug, 1921

The use of wedge rings will effectively compress packing rings long after they have lost their resilient properties. The wedging action forces the packing ring against the rod, effectively preventing the escape of steam.
Drawing included.

R-039
Roberts, I.
Gaskets and Bolted Joints
Jour.App.Mech., V.17, pp.169-179, June, 1950

Consists of a study of loading requirements of gaskets in bolted joints with the object of developing a rational basis for design of such joints.

R-040
Roberts, R.W.
Rotary Vacuum Seal
Brown Univ., M-6845, Contract AT (30-1)-2101 (4 pp.), Jan. 13, 1959

A brass rotary vacuum seal is described for use in a molecular beam experiment.

R-041
Roberts, R.W.
Rotary Vacuum Seal
Review Scientific Instruments, V.32, pp. 750-1, June, 1961

It was necessary to rotate a 40-lb. helical velocity selector at speeds up to 4200 rpm in a metal high-vacuum chamber. This was achieved by a rotating shaft going through a vacuum seal in the end flange of the vacuum chamber. The seal was divided into three sections by two No.63X3 silicone rubber Garlock "Klosure" seals, and two silicone rubber O-rings.
The center section is exhausted to a pressure of 1 x 10^{-3} torr by a mechanical pump. The high vacuum chamber pressure is 1 x 10^{-7} torr. At 1000 rpm, the pressure is 7 x 10^{-7} torr. Details and drawing included.

R-042
Roberts, V.
Coolable Vacuum-Tight Window Seals for Optical Use
J. Sci. Instrum, V.36, p.99, February, 1959

A flange is permanently soldered to the specimen chamber. An annular polyethylene gasket 0.005" thick is clamped between the flange and the window diaphragm by a retaining ring. The assembly is held together by sixteen screws. Seals of this type have been frequently used at liquid hydrogen and helium temperatures.

R-043
Robertson, D.D., Colvin, R.H.
Why Valve Packing?
Bus Transportation, V.15, pp.568-9, Dec., 1936

R-044 T
Robinson, C.S.L.
Flow of a Compressible Fluid Through a Series of Identical Orifices
ASME Trans., V.70, pp. 308-310, 1948

The author has used perfect gas laws and the assumption of constant initial enthalpy at each orifice to provide a straightforward method of flow calculation for air, saturated and superheated steam. Permissible errors in specific heat ratio K produces only small error. Method graphical and useful in design. (No experimental results included.)

R-045
Robinson, J.J.
Evaluation of Dyna-Seals for Use as Sealing Gaskets on Aircraft Gear Motors
DF61MD314 (5 pp.), GEL Tech.Data Center, G.E. Co., Schenectady, N.Y., April 26, 1961

Standard "Dyna-seal" gaskets were evaluated for use as a sealing gasket in conjunction with AN-type oil fill and drain plugs on aircraft-type gear motors utilizing MIL-L-7808 oil as a lubricant. It was concluded that the dyna-seal may be used for the stated purpose. A standard 110-5/16 Dyna-seal (product of Precision Rubber Products Corp., Dayton, Ohio) was evaluated. Tests have indicated that a more positive seal for MIL-L-7808 oil was obtained when this dyna-seal was substituted for the present AN-900-5 copper asbestos gasket.

R-046
Robinson, J.N., Lundin, M.I., and others
Development of Ring Joint Flanges for Use in the HRE-2
ORNL-TM-68 (51 pp., 53 ref.), Oak Ridge National Lab.

Report on Contract W-7405-eng-26.

R-047
Robinson, N.W.
Bakeable High Vacuum Seals
J. Scientific Instruments, V.34, p.121, March,1957

Plane flanges can be joined and baked repeatedly to 450°C using an all-metal seal which has been developed for use with high vacuum demountable apparatus. Two flat copper washers are separated by a steel ring which has annular knife edges formed on the upper and lower surfaces and a peripheral groove to allow a cantilever action of the knife edges when under pressure. Suitable dimensions are given.

R-048 T
Rodes, T.W.
Mechanical Seals for High Speed, Temperature and Pressure Applications
Industrial and Engineering Chemistry, V.43, Supp. pp 117A-118A, June, 1951

Increased operating ranges are noted for mechanical seals and credit is given to development of the balanced seal, and improvements in material.

R-049 T
Roeder, K.
Die Abdichtungsaufgabe im Dampfturbinenbau (In German)
Archiv. für Waermewirtschaft, V.18, No.15, pp. 147-150, May, 1937

This article discusses design principles for steam turbine packings.

R-050
Roger, V.
Rotary and Sliding Seals (In French)
Technique Moderne, V.42, pp. 149-53, May 1-15, 1950

Illustrated description of different types; references apply largely to American and British practice.

R-051
Rogers, D.T.
Mercury Seal for Stirrers
J. Am. Chem. Soc., V.5, p. 419, 1933

A Hg seal made of Allegheny metal No. 22 or mild steel coated with paint is good for speeds of 1000 rpm.

R-052
Rogers, P.R.
Pressure Seals for Reactor Mechanical Drives
Nuclear Eng., V.7, pp. 110-113, March, 1962

Details are given of the testing and development carried out on seals for rotating and reciprocating drives for various items of equipment associated with reactor gas circuits, charging machines, and service machines.

R-053
Rooke, N.F.
Aircraft Power Plant Seals
SAE Jour., V.61, pp. 23-29, July, 1953

Secretary's report of round-table discussion on aircraft power plant seals and their application held at SAE meeting.
Problems attendant to sealing against fuel leakage. Temperature range -65°F to 250°F, or higher, are covered.
O-rings, metallic seals, etc., are discussed.

R-054
Roper, R.S., Tipton, F.W. and Trepus, G.E.
Utilization of Plastics in Seals for Extreme Environments
SPE-Annual Tech.Conf. Paper 26-1, 1961

Study relevant to materials for space vehicles; experimental study of high temperatures, ionizing radiation and extremely low temperatures on sealing efficiency of O-rings; filled back-up rings; Mylar film for low temperatures.

R-055
Ross, W.S.
Design for 60 MW Steam Turbine to Take Steam at 1500 PSIG and 1050°F
Instn. Certificated Engrs. (S.Africa), V.32, No.8, pp. 249-259, August, 1959

Design and general construction of turbine; novel features included; methods of overcoming problems in use of available materials and in steam sealing for h-p cylinder and control gear; special reference made to use of austenitic materials where differential expansion is involved; gland sealing and leak-off system; oil systems and control gear.

R-056
Rossheim, D.B. and Markl, G.R.C.
Gasket Loading Constants
Mech. Engng., V.65, pp. 647-648, Sept., 1943

A review of the gasket-loading constants suggested in Table UA-7 of the A.S.M.E. unfired pressure vessel code.

R-057
Roth, A.
Calculation of "Leaky" Vacuum Installations
British Chemical Engng., V.6, pp.40-44, Jan., 1961

Methods of calculating the dimensions of leaky vacuum systems presented in this article include short-cut graphical procedures for estimating the permeabilities of seals, characteristics of vacuum pumps and of the pumping system in the presence of leaks. Also presented is a nomogram for determining the most economical operating conditions.

R-058 T
Rowell, H.S., Finlayson, D.
Screw Viscosity Pumps
Engineering, V.114, pp.606-607, Nov. 17, 1922

Pioneer paper to explain the theoretical basis of the screw pump performance. Assuming laminar flow, neglecting leakage flow past screw-bushing clearance and screw helix angle, the authors present an equation for maximum pressure which can be developed, and the discharge rate for simple screw viscosity pumps.

R-059 T
Rowell, H.S., Finlayson, D.
Screw Viscosity Pumps
Engineering, V.126, pp. 249-250, Aug.31, 1928
pp. 385-387, Sept. 28; Discussion, pp. 659-660, Nov. 23, 1928

This paper deals with the theoretical and experimental aspects of the screw viscosity pump. In an earlier paper by the authors, theoretical equations for pressure rise and flow were derived. Experimental results are presented to confirm the conclusion that pressure rise and discharge rate per unit cross sectional area of the groove increase as the ratio of the groove width to groove depth increased.

R-060
Royston, D.
Hydraulics for High Performance Aircraft - Why and How
Can. Aeronautical, V.5, No.6, pp. 233-242, June, 1959

Steps involved in choosing optimum power supply for flight concepts and utility services of high performance, supersonic interceptor aircraft. Reasons for choice of hydraulics and problems involved such as: choice of fluid, tube connections, reservoir design and temperature problem. Future trends relating to fluids, seals, etc.

R-061
Rudis, M.A.
Strength and Rigidity of Seal Rings
Russian Engrg.Jour., V.41, No.6, pp. 28-81, 1961

Static seals for joints in machines. Establishes the connection between the force of tightening acting on a seal of predetermined dimensions and the pressure, and gives formulas for determining the stresses.

R-062
Ruhl, F.F
High Temperature Face Seals
Mach. Design, V.20, pp.127-132, Jan., 1948

How hydraulic coupling and torque converter seals were developed. Steps leading to the design of successful high-temperature face seals.
Following seals investigated:
1. Metal diaphragm; 2. Face-type seals (single and double); 3. Bellows; 4. Lip-type and others.
Ten years of development in making seal units for hydraulic transmissions provided proof that a carbon-graphite material, "Graphitar," has best qualifications for seal rubbing member.

R-063
Rushing, F.C.
Centrifugal Pump and Shaft Sealing Means
U.S. Patent 2,951,448, Sept. 6, 1960

A description is given of sealing means between a hollow rotatable shaft and a stationary member surrounding the cross-section, comprising a plurality of axially-spaced rings held against seats by ring springs which serve to subdivide the sealing space into a plurality of zones.

R-064
Ruthberg, S., Creedon, J.E.
Aluminum Foil High Vacuum Gaskets
Rev.Scientific Instruments, V.26, p.1208, Dec., 1955

An aluminum gasket clamped between two Monel flanges serves very well as a simple, easily manipulated high vacuum seal which can be baked at 400°C. A thin gasket of this type avoids the problems associated with gasket expansion during bakeout. Flange design and drawings includdd. Performance record discussed. Temperatures and pressures down to 8×10^{-8} mm Hg.

R-065
Rutledge, F.S.
Lubrication Methods for Rod Packings
Power Plant Eng., V.38, pp.535-6, Nov., 1934

Shutdowns and many other engine and pump troubles can be avoided by proper attention to packing and its lubricants.

S-001 B

Sabanas, M.
Designing Seals With New Materials For Use At High Temperatures
Industrial Laboratories, V.10, pp. 16-24, October, 1959

S-002

Sabanas, M.
High-Temperature Static Seals From Metal Fiber Composites
Product Engineering, V. 31, pp. 57-61, May 30, 1960

Seals made by impregnating hard metal-fiber felts impregnated with compatible soft metals or polymers. The most common skeletal metals so far are stainless steel and molybdenum. Some soft metals used are tin, indium, silver and magnesium Air at 5000 psi and 1000°F is sealed by these seals. Mechanical properties and sealing characteristics of various types are given. Discusses the compatibility of materials, fabricating the seals, and the method of impregnation.

S-003

Sadowski, M.A.
Analytic Development of Desirable Stress Distrbution Characteristics in Sealing Rings Leading To Recommendation of Ring No.5 for Application to Closed Breech Launchers
PB-146215 Order from L.C. (WVT RR6006) (98 pp.), March, 1960

Laboratory testing of closed breech sealing rings, Nos. 1 and 4, and the mathematical analysis of those rings showed that they are prone to elliptic buckling and plastic flow due to stress concentration at the lips. Ring No. 5 was then designed on the basis of mathematical shell theory. It is believed that it will be as nearly free from those faults as possible. It is suggested that Ring No. 5 be produced and evaluated experimentally.

S-004 T

Saibel, E., Lyman, F.A.
A Theoretical Investigation of Leakage Through Rotary Shaft Seals
Report #850489, U.S. Naval Eng. Experiment Sta., Annapolis, Nov. 28, 1961

It was shown that the effect of face waviness, nonparallelism of faces, or a notch in the seal face could be sufficient to generate a fluid film between the faces. Approximate solutions to the Reynolds' equations are derived by using perturbation methods, and comparison with previously published results shows fair agreement.

S-005

Salzmann, F. and Fravi, P.
Valve Spindle Leakage
Escher Wyss News, V. 10, pp. 88-92, July-Sept., 1937

Methods of estimating leakage at the spindle of steam turbine valves. This article consists entirely of formulae and numerical examples.

S-006

Salzman, P.K. and Schell, F.N.
S2G Valve Sodium Freeze Seal Evaluation
Knolls Atomic Power Lab., Schenectady, N.Y.
KAPL-M-EDL-125 Contract W-31-109-eng-52 (50 pp.), Nov. 20, 1956

The design of the S2G 8-inch sodium stop valve freeze seal was evaluated under established conditions by cycling before and after a simulated bellows failure.

S-007

Samuel, A.J.
Grooveless Flange-Gaskets and Their Installation
U.S. Atomic Energy Commission, Oak Ridge, July, 1944, 13 drawings, AECD 2685, PB-100704, Off. Tech. Serv.

The gaskets are shown in drawings and were designed to be used with 2", 3", 4", and 6" standard ASA 150# forged steel welding neck flanges respecitvely, having 1/16 inch between flanges. Method of installation, mechanical details of the mold.

S-008

Sancier, K.M.
Vacuum Tight, Flexible Metal Glass Seal
Rev. Sci. Instruments, V.20, p. 958, December, 1949

A sleeve of Saran tubing can be used to form a vacuum tight, flexible seal between metal or glass tubing.

S-009

Sanders, W.E.
The Development of Non-Metallic Packings
Power, V. 29, Aug. 25, 1908

A review of early forms of packing, giving classification, and stating objections to monkey-wrench packings.

S-010

Sanders, W.E.
Moisture and Expansion Packings
Power, V. 29, Sept. 1, 1908

Describes the packings, especially the manufacture of rubber packings Ills.

S-011

Sanders, W.E.
Automatic Steam and Ammonia Packings
Power, V. 29, Sept.8, 1908

A discussion of the advantages, cost, and application of diagonal or automatic packings, and of packings for high temperatures and ammonia.

S-012 T

Sanderson, H.C.
Back Diffusion in Labyrinth Seals
Report KL-1188, Oak Ridge Gaseous Diffusion Plant, Union Carbide Nuclear Co., Oct. 23, 1961

In the seal system proposed for the experimental gas cooled reactor, labyrinth seals were employed to prevent the back diffusion of the buffer fluid (water) into the cycle fluid (helium). There was no evidence of back diffusion under any of the test conditions which were:

System temperature	-	80°F to 500°F
Steam pressure	-	25 psi to 250 psi
Δp across labyrinth	-	0.1 psi to 10 psi
System gas	-	air or helium

S-013
Sandstrom, C.O.
Gaskets For Pressure Vessels And Heat Exchangers
Chem. & Met. Engng., V.41, pp. 130-134, March, 1934

Flange-type sealing using both metal and non-metal materials; gasketless joints; crushing resistance of gaskets; special type gaskets such as wire, corrugated, and ring; temperature differences and effects on flanges.

S-014
Sass, F.
A New Stern Tube Packing for Seagoing Ships and River Boats
Konstruktion, V.2, No.11, pp. 321-325, 1950
Spec. Lib. Assn. Trans. 58-713 (18 pp.), V. 4, No.5, May, 1958

S-015
Saunders, R.D.
Quality Control in the Use of O-Rings
Approach, V. 7, pp. 34-38, 40, 41, June, 1962

Discussion of the use of O-ring seals, covering: (1) the sealing principle; (2) the selection of compounds; (3) causes of failure; (4) rules for proper installation; (5) O-ring gaskets; and (6) the evaluation of leakage.

S-016
Saunier, W.P.
Keeping Steel Gaskets Tight At 1350 PSI
Power, V.72, pp. 22-23, July 1, 1930

The use of copper-plated gaskets of dead-soft steel on high-pressure steam lines; specifications and sizes used.

S-017 B
Sawyer, D.W. and Paull, D.A.
Teflon Insert Compression Rings in Radial Gas Engines
A.S.L.E. Paper 60 AM 4C-1 (9 pp., 4 fig.), April, 1960

This paper gives the results of tests to determine the possibilities of Teflon inserts in piston rings which were performed at a plant operating approximately 250 gas burning Nordberg engines. Results sufficiently important to warrant further work in this field.

S-018
Sawyer, J.W. and Crawford, L.
A Mercury Shaft Seal
Am.Soc.Nav.Engrs.Jour., V.62, pp.349-363, May, 1950

This paper discusses a seal which opposes fluid flow by means of an internal pressure field. This is accomplished through the use of a centrifugal mercury seal supplemented by a positive contact seal. This paper describes attendant problems and a test model.

S-019
Saxon, A.F.
Multistage Sealing
Machine Design, V.25, pp. 170-172, March, 1953

Sealing a rotating shaft against pressures to 5000 psi at temperatures to 600°F demands more than ordinary means of sealing. How multistage sealing can be effectively applied under such service conditions is demonstrated by an autoclave design. Experimental models of the stuffing box have been successfully operated at pressures of 10,000 psi and higher.

S-020
Scepaniak, A.
New Seal Reduces Shaft Wear
Plant Engineering, V.13, pp.98-99, Nov., 1959

S-021 T
Schaffer, R.
Mechanical Seals For Centrifugal Pumps In The Chemical Industry (In German)
Chemie-Ing-Techn, V. 29, No.4, pp.241-249, 1957

This paper presents a basic practical study of mechanical seals for centrifugal pumps used in the chemical industry. Attention is given to materials of construction for corrosive media, and permissible temperature and pressure limits are discussed. A limited number of experimental observations are presented.

S-022
Schaphorst, W.F.
Blowproof Gasket
Textile World, V.69, p. 3047, May 1, 1926

S-023
Schmidt, E.G.
Flanged Joints, Their Development and Trend
Proceedings of National Conference on Industrial Hydraulics, V.II, pp. 33-42, 1948

Present briefly a picture of the development of flanged joints, the factors influencing their development, and work done to create joints which are simple, positive action, and easier to use. Test results, and curves included.

S-024
Schmidt, J.D.
Turbine Sealing Glands
Power Plant Engrg., V.46, pp. 86-87, Feb., 1942

A seal is necessary to prevent leakage along the shaft from the high-pressure end and the leakage of air inward on the vacuum end.
Stuffing boxes are impractical.
Types used are labyrinth, the carbon ring and the water seal, used alone or in combination. These are discussed pro and con.

S-025
Schmitz, C.E.
Mechanical Seals
Lubrication Eng., V.2, pp. 162-5, Dec., 1946

Problems encountered in packing or sealing rotating shafts; factors involved; influence of operating conditions such as temperature, pressure, nature of material being sealed, space requirements, and lubrication of rubbing surfaces of seal, in design of mechanical seals; construction requirements, application example in mechanical field are cited.

S-026
Schmitz, C.E.
A Look Inside the Mechanical Seal and Design Consideration
Lubrication Engng., V.4, pp. 14-17, Feb., 1948

Considerations in the choice and design of shaft seals: 1. Flexibility, 2. Surface finish of mating parts, 3. Laboratory testing, 4. Metallurgy, 5. Engineering. These plus application problems are discussed.

S-027
Schmitz, C.E.
Mechanical Seal: Its Construction, Application, and Utility
Paper Trade J., V.127, pp.21-5, Dec.16, 1948

Outline of important design features; factors of speed; pressure, temperature, and viscosity; advantages; when special construction is desirable; utility of mechanical seal in refrigeration compressors, pumps, engines, etc.

S-028
Schmitz, C.E.
Hydraulic Packing and Seals
Applied Hydraulics, V.2, pp. 8-10, Feb., 1949, pp. 14-16, April, 1949

Survey of compression and self-sealing types of packings, including new materials, available for hydraulic applications; important factors concerning packing problems are discussed; angularity; number of rings; spring loading; following construction factors of typical mechanical seals, positive driving means, metallurgy, and engineering, laboratory testing and research application problems.

S-029
Schmitz, C.E.
The Mechanical Seal; Its Construction, Application And Utility
ASME Trans., V.71, pp. 635-641, Aug., 1949

Paper outlines important construction features of the mechanical seal; discusses speed, pressure, temperature, and viscosity; application considerations, advantages, and when special construction is desirable; utility of the mechanical seal; and suggested services.

S-030
Schmohl, L.H.
Sealing and Holding Separate in New O-Ring Standard
SAE Journal, V.64, pp.92-93, April, 1956

Sealing is accomplished by a synthetic rubber ring being compressed in a cavity between the fittings and the boss in the pumps, valves, or other components. Recommended usage discussed. Temp. 65°F to 212°F. New standard developed. Drawings included.

S-031
Schneckenberg, E.
Flow Through Narrow Concentric and Eccentric Circular Slits
Zeits f. Tech. Physik, V.11, No.9, pp.354-7, 1930

The author gives an insight into the present-day demands with respect to throttle packings for pumps and describes a practical process for making very narrow circular slits of width which can be accurately ascertained. Flow experiments are described for various types of packings with diagrams and illustrations.

S-032 T
Schneckenberg, E.
Flow of Water Through Concentric and Eccentric Cylinder Packing Glands With and Without Annular Grooves (In German)
Zeitschrift fur Angewandte Mathematic und Mechanik, V. 11, pp. 27-40, 1931

This paper is an extremely detailed report of experiments performed by the author. Calculations are based on equations derived by Becker. The experimental flow rates, which are presented graphically, provide a measure of the effectiveness of cutting annular grooves. Effects of eccentricity are included.

S-033
Schrader, E.W.
Face Type Seals For Rotating Shafts
Design News, V.15, pp. 6-7, Aug. 15, 1960

Face-type seals previously used almost exclusively on rotary pumps and primarily on centrifugal pumps. Recently, the seal has been used for special application with high speeds and pressures. Increased use of metal bellows has expanded their use to exotic fluids and much wider temperature ranges. Standard and stock seals available for temperatures from -450°F to 1000°F. Pressure limit 500 psi.

S-034
Schrader, E.W.
O-Ring Squeeze For Dynamic Sealing
Design News, V. 16, pp. 4-5 , Sept. 1, 1961

Factors affecting O-ring seal for reciprocating motion. Data curves presented.

S-035
Schuster, E.C. and Rupe, V.L.
Save Money With O-Rings
Petroleum Refiner, V.34, No.11, pp. 201-204, Nov., 1955

Testing synthetic rubber O-ring flanges; it is concluded that testing 300 ASA flange with O-ring can give cold service pressure ratings equal to 600 ASA ring joint for sizes up to 12 inches.

S-036 T
Schwaigerer, S., Seuffert, W.
Investigations on the Sealing Capacity of Sealing Strips (In German)
Brennstoff-Waerme-Kraft, V.3, No.5, pp. 144-148, May, 1951

This paper presents the results of sealing tests of flat and profiled sealing strips which were investigated with various pressurized fluids and various surface finishes. On test bases, relations can be formulated for the calculation of the critical sealing pressure which is required for alignment of the sealing surfaces in addition to that sealing pressure which is required during operation for a permanent seal.
(Included here since the gland of a mechanical face seal or buffered housing must be sealed statically with the housing of the compressor or turbine.)

S-037
Schweickhart, O.
Balanced Packing Rings (In German)
Waerme, V. 60, pp. 19-22, Jan. 9, 1937

Discussion of metal packings for use between parts in relative motion (piston rings); constructional features and pressure conditions of a number of different designs of partially and fully balanced rings for single and double-acting pressure.

S-038
Schweiger, F.A.
Dynamic Seals
DF59FPD659C - Sm. Av. Eng. Dept., G.E. Co., Lynn, Mass.

Discussion of dynamic seals including: types and selection, circumferential seal, segmented carbon ring seals, controlled gap seal, labyrinth seals; their advantages and limitations.

S-039
Scott, P.A.
PRTR Mechanical Seal Pump Operating Experience. Sept. 1958-Aug. 1960
HW-65724 Rev., GEL Tech.Data Center, G.E. Co., Schdy, N.Y.(68 pp.), Sept. 16, 1960

The plutonium recycle test reactor (PRTR) is the first large high temperature-high pressure reactor for which mechanical seals will be used in the primary pumps. The faces run on a lubricating film of the liquid being pumped. In this case, the liquid, heavy water, is recovered by equipping the pump with two mechanical seals in series on the shaft in such a way that leakage is returned to the system.
Report relates experience gained from operation of the spare PRTR Primary Process Pump, and of a small pump with prototype mechanical seals and shaft assembly. Operated at temperature and pressure conditions prototypical of the PRTR.

S-040 T
Secord, J.R., Chapin, E.A.
Rotary Shaft Seal
U.S. Patent 2,916,314, Dec. 8, 1959

A seal designed to withstand translatory gyrations and axial vibrations which occur at the rear main bearing of an automobile engine crankshaft. Sealing action is by a piston type ring, either split or solid, which is maintained in contact with a shoulder on the rotating member by a corrugated annular spring ring.

S-041
Seki, H.
Simple Demountable Indium O-Ring Seal Tight To He II
Rev. Sci. Instr., V.30, pp. 943-4, Oct., 1959

An indium O-ring was used to seal an isolated chamber to He II at 10^{-5} mm Hg, and no appreciable change in pressure was detected as the λ point was passed.

S-042
Seufert, W.
Investigations of Packing Efficiency of Joint Surfaces (In German)
Brennstoff-Waerme-Kraft, V.3, pp. 144-8, May, 1951

Tests on different types; results show that no packing is absolutely impervious to gases and not entirely impervious even to liquids; complete impermeability can be achieved only when packing surfaces are plastically deformed.

S-043
Sharapov, G.A.
New Type of Gland Packing
KhimicheskayaProm, V.8, pp. 18-19, 1944

Glass-fiber waste was twisted into a cord and successfully used as a gland packing for pumps handling corrosive liquids.

S-044
Sharapov, G.A.
Gland Packing
S. Khimicheskaya Prom, V.2, p. 21, 1945

The packing withstood 65-75% H_2SO_4 containing 0.01-0.2% of HNO_3 at 35-170°C.

S-045 B
Shatford, P.A.
O-Ring Sealed Vacuum Valves
Journal of Scientific Instruments, V.29, No.10, pp. 336-7, Oct., 1952

Half-page description and sketches of a two-way, and an isolation valve.

S-046
Shaw, C.J.
Laboratory Test and Evaluation of Seals Used in the Propellant Line Systems
Douglas Aircraft (3227), Mar. 30, 1960

Determine sealing capacities of gaskets used with liquid oxygen and fluid systems.

S-047
Shaw, G.V.
Mechanical Shaft Seal for Centrifugal Pumps
Oil & Gas J., V.42, p. 251, April 13, 1944

Light liquids, high pressures and speeds have necessitated development of more reliable and economical means of sealing rotating shaft than can be obtained when using conventional stuffing box and packing; with drawing showing essential design details.

S-048 T
Shaw, M.C., Nussdorfer, T.J.N.
An Analysis of the Floating Journal Bearing
NACA Report No. 866 (13 pp.), 1947

An analysis of the operating characteristics of a full-floating journal in which a floating sleeve is located between the journal and bearing surface. The whirl of the floating bushing is briefly considered.

S-049 T
Shenton, F.
Outside Type Seal
U.S. Patent 2,252,526, Aug. 12, 1941

A shaft seal designed for use in a refrigeration compressor or similar device where the sealed pressure may fluctuate above and below atmospheric pressure. The seal is designed for use external to the compressor. The sealing mechanism centers around two "C"-shaped rings placed back-to-back in opposite directions which are forced into contact with the shaft by a pressure unbalance in either direction.

S-050 T

Shenton, F.
Shaft Seal
U.S. Patent 2,323,730, July 6, 1943

A shaft seal assembly such as might be used on a compressor crankshaft where pressure would fluctuate from positive to negative. A pressure differential across two flexible "C"-shaped annular seal rings, between a sliding collar and rotating fixed collar, aids springs in holding wear ring against the seal nose. An oil circulation system for oil retention is also included.

S-051

Shepherd, H.F.
Seals Perfect Lubrication System
Machine Design, V.5, p. 23, Nov., 1933

Advantages of using unit oil seals embodying specially treated "hot leathers" in pressed steel case; If shaft is not required to penetrate housing wall, single leather seal confines oil admitted through feed tube, forcing it to take path through shaft bore, whence it may be directed as needed.

S-052

Shepler, P.R. and Noren, O.
Split-Ring Seals
Mechanical Design, THE SEALS BOOK, pp. 24-31, Jan. 19, 1961

Split rings are used for a large number of seal applications. Expanding split rings (piston rings) are used in compressors, pumps, and internal combustion engines.
Use of contracting split rings or rod seals in linear actuators is increasing where high pressure, high temperatures, radiation, thermal fatigue, and need for reliability prohibit the use of more conventional seals or make them less desirable.
A table, "Key Principles of Sealing," is included as is a table, "Corrosion-Resistant Material," covering medium-temperature seal material and seal application.

S-053 B

Sibley, L.B. and Nace, A.E.
Characteristics Governing the Friction and Wear Behavior of Refractory Materials for High Temperature Seals and Bearings
Battelle Memorial Inst., WADD Tech.Report 60-54 (54 pp.) (PB 171010), May, 1960

Various ceramic and cermet materials have been evaluated for unlubricated wear resistance at high sliding speed (100-200 fps) and low unit load (5 and 50 psi) in 100 and 1800°F air. A statistical correlation was obtained between the measured wear rates under these conditions and the coefficient of friction, thermal stress-resistance, and the thermal diffusivity of the mated materials on which wear predominated.

S-054

Siebel, E. and others
Tests on the Performance of Gaskets (In German)
Forsch. Gebiete de Ingen., V.5, pp. 298-305, Nov.-Dec., 1934

The purpose of the above investigation was to obtain numerical data concerning the forces necessary for various shapes of packing and materials in order to obtain a tight joint at given pressures. Data of this kind is indispensable if useful methods of calculation are to be obtained for flange connection. Tests were carried out on the behavior of packing materials at room temperature with water as a pressure medium as well as at 350°F with steam.

S-055 T

Sikorski, J., Woods, H.J.
Rotary Vacuum Seal
Jour. of Scientific Instruments, V.30, p. 43, Nov., 1953

A mechanical face seal was tested for its performance under vacuum. A pressure of 2×10^{-4} mm Hg was sustained for 220 hours in a 1.5 liter container with 1" shaft rotating at 600 - 900 rpm. Vacuum was obtained by a Metropolitan-Vickers 03B oil diffusion pump in series with a two-stage rotary pump. Apiezon oil "B" was used for the seal. Improvement could be accomplished by improving the seal.

S-056

Sinclair, J.B.
How and Why Of Seals And Their Installation
Paper Trade Journal, 141:40, July 8, 1957
Coal Age, 62:98+, Sept., 1957
Brick and Clay Rec., 131:67, Oct., 1957

S-057

Sinclair, J.B.
Correctly Installed Seals Prevent Damage and Down Time
Petroleum Engr., V.29, No.13, pp. D23-24, Dec., 1957

Installation of leather and rubber seals to protect vital parts of earth moving machinery; installation of lip seals.

S-058 T

Sitney, L.R.
High Speed Rotary Vacuum Seal
Review of Scientific Instruments, V.23, pp. 505-6, 1952

This seal has operated satisfactorily for speeds up to 18,000 rpm at pressures to 8×10^{-6} mm Hg. It is believed suitable down to 1×10^{-6} mm Hg. Two Garlock Klozures with a guard vacuum between them are employed in the seal.
(Garlock Klozures are rubber lip seals.)

S-059

Skarstrom, C.W.
Sealing Means For Relatively Rotatable Members
U.S. Patent 2,957,709

A sealing means is offered for maintaining a seal between a pair of relatively rotatable members, particularly between a rotating shaft and a stationary member surrounding the shaft.

S-060

Skarstrom, C.W.
Seal for High Speed Centrifuge
U.S. Patent 2,816,704, to US A.E.C.

A seal is described for a high-speed centrifuge wherein the centrifugal force of rotation acts on the gasket to form a tight seal.

S-061
Skinner, E.T.
Graphite-Impregnated Rubber Packing for Reciprocating Pumps And Oil-Well Stuffing Boxes
ASME Preprint No. 51 (4 pp.), PET-17, 1951

Paper explores the use of graphite-impregnated rubber as a possible material for making mechanical rubber goods subjected to abrasive wear, e.g., gland packings for slush pumps.

S-062
Skow, N.A.
Plastic Laminates Bonded To Other Materials
Matls. & Methods, V. 45, No. 4, pp. 118-121, April, 1957

Design advantages offered by thermosetting laminates when combined with other materials such as steel, aluminum or rubber; material and forms available; use of combination laminates as structural materials for plating rolls, aircraft shock strut piston heads and precision bearing retainers, as electric materials for printed circuits, etc., and as sealing materials.

S-063 T
Smaardyk, A.
Summary of Shaft Seal Tests for High-Temperature, High-Pressure Water Application
Argonne Nat'l. Lab. ANL-5220 (33 pp.), April, 1954

Summary of program directed toward the development of an all-metallic seal assembly for use in connection with the design of external control rod drive activating mechanisms for pressurized, water-cooled reactor systems. Temperatures up to 450°F, pressures up to 2000 psig.
Specifications, drawings and test data included.

S-064
Smith, A.M.
Radioisotopes as Design Tools: Gasket Leakage
Product Engineering, V.26, p. 134, May, 1955

A technique to find the origin of leaks and determine whether design changes were advisable. Use of a soluble radio isotope in the cooling water offered promise on the assumption that activity would be deposited at any point where liquid evaporated to dryness. After running a test, the gasket could be removed and placed in contact with X-Ray film to show the leakage pattern. Test procedure and results presented.

S-065
Smith, J.N.
How To Apply V-Leather Packings
Product Engng., V. 7, pp. 141-142, April, 1936

Advantages of V-leather, the factors that determine the thickness, proportions and number to use and how to support them in the stuffing box; with tables and illustrations.

S-066
Smith, J.N.
Design and Materials For Hydraulic Packings
Aero Digest, V.40, pp. 119-120, 122, April, 1942

Hydraulically-operated units in the aircraft industry subjected to extreme service conditions. Packing must withstand all of following conditions. Pressure 0-3000 psi, temperature -40°F to 158°F. Material problems attendant to these operating norms are discussed. Leather is cited as most nearly perfect material available. Its advantages and limitations are discussed as are certain design problems.

S-067
Smith, J.N.
Hydraulic Packings For Industrial Equipment
Mach. Design, V.21, pp. 155-160, Dec., 1949

Standardization of hydraulic packings by sizes and types to simplify selection and reduce sizes and inventories worked out. Article presents information towards this end.

S-068
Smith, J.N.
Theory and Design of Large Diameter Packings
Proceedings National Conference on Industrial Hydraulics, Vol. V, pp. 121-130, 1951

Discusses packings up to 100" dia., up to 140,000 psi. Machining tolerances, surface finish, eccentric loading. Outside vs. inside packings, and their respective advantages.

S-069 B
Smith, J.N.
Adaptors for "V" Ring Packings
Machine Design, V. 32, 7, pp. 138-40, March 31, 1960

Metal, leather, hard homogeneous rubber, and phenolic adaptors are compared, and test results and data presented. Qualitative adaptor comparisons and recommendations are made.

S-070
Smith, J.N.
Molded Packings
Mechanical Design, THE SEALS BOOK, pp.58-67, Jan. 19, 1961

Molded packings are often called automatic, hydraulic, or mechanical packings. As a group, these packings usually do not require any gland adjustment after installation. The fluid being sealed supplies the pressure needed to produce the force for seating the packings against the wearing surface.
Two categories are lip and squeeze types. The lip-type includes flange, cup, "U" cup, and "V" ring packings.
The squeeze-type includes the O-ring and other similar forms which rely on the interference built into the ring for effective sealing.
Leather, rubber and Teflon are used.
Leather, -65°F to +200°F.
Rubber, -65 °F to + 500°F.
Teflon, upper limit +500°F- suffers from lack of resilience.

S-071
Smith, J.N.
Compatibility of Seals With Modern Hydraulic Fluids
Lubrication Engrg., V.18, pp. 320-323, July, 1962

Operating compatibility (not chemical) of dynamic seals with hydraulic fluids. Importance of knowing a mineral oil's aniline point and the anticipated operating temperatures of the fluid before selecting the packing material. Tabulates properties of synthetic rubber packing materials.

S-072
Smith, J.R.W.
Demountable Vacuum Seals
J. Sci. Instrum., V.29, p. 131, April, 1952

Three types of seals are described. One is a Wilson-type seal suitable for use with a glass end plate on a vacuum system. An O-ring rests on the highest part of the flange. On the inside, the O-ring is supported by a metal ring. Up to eight seals of the latter kind have been used with success in vacuum systems operating at pressures of 3 x 10^{-6} mm Hg.

S-073
Smith, L.H., Jr.
T-58 Guide Vane Pneumatic Actuator Seal
Tech.Proposal, Gen.Eng Lab., G.E. Co., Schehectady, April 15, 1960

Recommendations are made for a low friction piston seal to be incorporated in a small pneumatic actuator. The program includes design and fabrication of a suitable seal; procurement of a commercial seal; design and fabrication of test equipment, and test evaluation of the seals. C arbon piston rings and a spring-loaded "U" type seal are considered.

S-074
Smith, L.L.
Composite Inorganic Resilient Seal Materials
WADC Tech.Report 59-838, Part III, May, 1959

The principal objectives of this research program is to investigate and develop composite materials suitable for use as static and dynamic seals at temperatures ranging from cryogenics to 1200°F, and pressures up to 5000 psi.
1. Fibrous composite with pure metal impregnants.
2. Fibrous composites with other impregnants.
3. Non-fibrous composites (talc or glass).
Studies of resilience, fiber orientation, friction and wear, static seals, reciprocating and rotating shaft seals.

S-075 T
Smith, M.I., Fuller, D.D.
Journal-Bearing Operation at Superlaminar Speeds
Trans. Amer. Soc. Mech Engrs., V. 78, pp. 469-474, April, 1956

Results of investigation of load-carrying capacity and frictional characteristics of a journal bearing which was operated at speeds up to five times the critical (laminar breakdown of film) speed. The frictional behavior of the unloaded bearing was such that regions of laminar, transition, and turbulent flow could be defined.

S-076
Smith, W.R.
A Quick-Change Seal Opener
Rev. Sci. Instrum., V.24, pp.886-887, Sept., 1953

In case of the ORNL 86-inch cyclotron, the target assembly is water cooled and designed to be rotated or displaced in a linear direction. The stem of the assembly terminates in a water header which is fitted with three Wilson-type seals made from koroseal gaskets. The seal opener described in this note is designed to simplify insertion of the stem. It consists of a nut inserted into the seal body in a position concentric with the cylindrical bore accommodating the target stem. The new arrangement reduced the time required for changing the target assemblies to 5 minutes, equal to 1/5 the total time required previously.

S-077
Smoley, E.M.
How To Check Compression Characteristics Of Gasketed Joints
Mach. Design, V.28, pp. 76-78, May 17, 1956

This article describes a quantitative method of test called the "solder plug test," that can be used for approximating gasket compressions in an application. Also shows how the test is used for evaluating flange bending or bowing. Also points out some general procedures that can be used for analyzing leak problems and salvaging faulty flange designs.

S-078
Smoley, E.M.
Flange Pressure In Gasketed Joints
Machine Design, V.30, pp.133-137, June 12, 1958

Flange pressure is a critical factor in gasketed joints. Little information is available to specify the minimum sealing load for a given gasket material or to relate this load to flange-bolt torque, at best an uncertain criteria.
Procedures for handling such problems are discussed.

S-079
Smoley, E.M.
How Gaskets Behave
Prod. Engng., V.30, pp.40-42, May 25, 1959

Sparked by more aluminum in auto engines, gasket design techniques are being overhauled to fight high-temperature loosening. Presented is the latest research about the way typical gasket materials behave in aluminum-steel joints cycled to 300°F.

S-080
Smoley, E.M.
Nonmetallic Gaskets
Mechanical Design, THE SEALS BOOK, pp.83-89, Jan. 19, 1961

Joint and gasket design must be considered together. A joint is only as good as its gasket and the gasket may succeed or fail according to whether or not the joint is designed and constructed to make the best use of the properties of the gasket material. Therefore, the joint components must be thought of as a unit or as a system for effecting a seal.
The mechanical factors of joint design for nonmetallic gaskets are defined, requirements are set up, and an empirical solution to the problem is given. The various nonmetallic gasket materials are discussed, and recommendations are provided for their proper selection.

S-081
Smoley, E.M. and Frazier, E.C.
Nonmetallic Gasket Materials And Forms
Mechanical Design, THE SEALS BOOK, pp.90-99, Jan. 19, 1961

Material must meet following requirements: 1. Impermeability, 2. Ability to flow into joint imperfections when compressed, 3. Maintain seal in spite of age, temperature, and pressure variations, 4. Resist environmental deterioration.
Gasket materials, tables, form, seating stresses.

S-082
Smoley, E.M.
Retaining Tension in Gasketed Joints, Part I
Assembly and Fastener Engineering, pp.30-34, Sept., 1961

Describes some reasons why bolt tension is reduced in ball flanged joints. Shows effect of gasket materials, thickness, bolt length, flange materials, etc.

S-083 T
Snell, L.N.
Theory of Viscosity Thrust Bearing Based On Circular Geometry
United Kingdom Atomic Energy Authority, IPDC (14 pp.), p. 137, 1959

The Whipple Theory of the viscosity plate thrust bearing is based on the assumption that the radius of the plate is large compared with the width of the pumping portion. The paper contains a modified theory which takes full account of the circular nature of the plates. It is shown that such a modification will not reduce the discrepancy between theory and experiment.

S-084
Sniffen, T.J.
How To Select And Install Pump Seals
Petroleum Refiner, V.35, No.3, pp.207-210, March, 1956.
Pipe Line Industry, V.5, No.1, pp. 34, 39-40, 42, July, 1956

Principles of mechanical seal performance, maintenance and method for preventing its failure; seal selection, material, and installation precautions.

S-085 T
Sniffen, T.J.
Mechanical Seals From A to Z
Power and Fluids, pp.20-23, Winter, 1958
"Basic Principles of Mechanical Seals," Product Engineering, V.29, pp.12-14, Mid-Sept., 1958

This article describes mechanical seals with respect to basic seal elements, operation, selection, installation, and materials.

S-086
Soderholm, L.G.
Fiber-Metal Seals Allow High Temperature-Pressure Operation
Design News, V.16, 90-91, June 19, 1961

Fabrication of high-temperature, high-pressure static seals using sintered and brazed skeletons of Mo and stainless steel fibers impregnated with melted I_n and A_g by compression under vacuum and in an Argon atmosphere. Data are given for compression and recovery measurements, thermal cycling and hydraulic leak tests at various temperatures to 1000^{o}F and pressures to 5000 psi at varying impulse cycles.

S-087
Soderholm, L.G.
Integral Cross Seals Tighten Half Seal Sections
Design News, V.16, No.21, pp.28-29, October 13, 1961

A new one-piece half-seal has molded projections extended radially from the end of the semi-circular half seal section. These projections fit into a groove in either the lower or upper support members. The cross-seal projections do not fill the groove entirely when they are placed in position, but project slightly above the face of the receiving support member. When the top surface is placed in position and assembled, the cross seal projections are compressed and flow downward and outward into their grooved slots.

S-088
Somerling, H.
Contribution to Calculation of Labyrinth Packings
Revue M de la Mecanique, V.3, pp. 47-59, April, 1957

Critical examination of existing calculating methods; causes for inaccuracy of Stodola formula; new more exact method developed is based on theoretical considerations and on laboratory results obtained on experimental installation.

S-089
Sondermann, H.
Design of Packings and Gaskets For Hydraulic Pressures (In German)
Maschinen Konstrukteur, V.64, pp.231-4, Dec.10, 1931; V.65, pp. 8-9, Jan. 10, 1932

Dec.10: Design of packings and gaskets for high hydraulic pressure.
Jan. 10: Dimensions of packing of convex or concave type suitable particularly for double-acting pistons.

S-090
Sondermann, H.
High-Pressure Hydraulic Gland Packing
Engrg., V.136, pp.325-6, Sept. 22, 1933

A study of the design of high-pressure glands used in hydraulics. The design and use of "U" and "V" leathers in hydraulic rams.

S-091
Spain, R.G.
Compounds For High Temperature Fuel Seals And Their Testing Under Simulated Use Conditions
Included in WADC Tech.Report 57-478, Elastomeric for Air Weapons; WADC, Univ. of Dayton Conference, Oct. 1957

S-092
Spain, R.G., Lajiness, W.G. and Deck, E.
Research and Development On High Temperature Fuel Resistant Rubber Compounds
Wyandotte Chemicals Corp., Wyandotte, Mich., WADC-TR-55-492 (Rt.4); Contract AF33(616)-5544, Project Nos. 7340 and 3048 (90 pp.), Feb.18, 1959

The development of elastomeric compounds resistant to high energy fuels (HEF) at elevated temperatures is described. Description of test methods used.

S-093 T
Spaulding, D.C., Jr.
Non-Rubbing and Rubbing Seals For Oil Retention
Product Engineering, V.26, pp.42-5, Mid-October, 1955

These two articles present a pictorial description of methods of retaining lubricant in bearings. Included are various types of labyrinths, lip seals (felt and rubber), and mechanical face seals. Applications are given.

S-094
Spees, A.H. and others
Vacuum Gaskets at Low Temperatures
Review of Scientific Instruments, V.28, p. 1090, Dec., 1957

Soft aluminum wire has been used successfully as a gasket material for vacuum systems. It is of particular importance in low-temperature work and has proved to form a satisfactory seal in liquid helium I and II.

S-095
Spence, E.L.
Increasing Packing Life
Chem. Engng., V.59, pp. 200-201, Feb., 1952

A little extra care in storing, installing, and lubricating packings can greatly increase their life. Suggestions for accomplishing this are given.

S-096
Spitsyn, N.A.
Basic Designs of Seals For High Speed Roller Bearings (In Russian)
Vestnik Mashinostroeniya, V.39, pp.3-8, Sept., 1959

Survey of various types of seals to avoid passage through journal into vacuum chamber of air, gas, oil or other materials; selection of insulation is made in relation to rotation velocity.

S-097
Sprigg, E.A.
Bonded Gaskets Solve Sealing Problems in Die Cast Assemblies
Die Casting, V.4, pp. 70-72, March, 1946

Use of molded synthetic rubber gaskets provides means of eliminating extra handling operations in assemblies where a gasket member is required for sealing.

S-098
Spruck, R.F. and others
Use Metallizing Tape For High Quality Ceramic Metal Seals
Cer. Ind., V.79, pp. 88-91, Sept., 1962

S-099
Squire, J.W.
Uprate Flanges With An O-Ring Seal
Oil and Gas Journal, V.56, pp.111-113, Oct. 20, 1958

Advantages of using an O-ring seal with flat-face flanges for the ASA 300 welding-neck series up to the 24-in. size are pointed out in this report. Discussion of flange design, bolt stresses, and practical considerations.

S-100
Stahl, E.P.
Ball and Roller Bearing Seals
Product Engineering, V.18, pp.103-6, April, 1947

Designs of common types of oil and grease seals for excluding foreign material from ball and roller bearings are shown. Proper application of different types of seals are discussed. Typical seal arrangements for industrial and automotive equipment are described.

S-101
Stahl, E.P.
Selection of Seals of Various Duties
Machinery, V.81, pp. 367-73, 1952

Discussion of types of seals:
1) Simple felt seals act as reservoirs
2) Metal labyrinth
3) Unit type - spring loaded leather seals
4) Unit type - synthetic rubber seals
5) Unit type - with double leather or synthetic rubber sealing members
6) Springless unit type seals
7) Mechanical seals

S-102
Stahl, E.P.
Sealing Devices For Sleeve Bearings
Electrical Manufacturing, V.53, pp.133-6, June, 1954

Review of available types of seals and their proper selection for lubricant retention and dirt exclusion.

S-103
Stahl, E.P.
Correct Practice For Oil And Grease Seals
Power Engineering, V.61, pp.70-72, Dec., 1957

To do a good job, any ball and roller bearing seal must: 1) retain lubricant in the bearing, 2) prevent dirt from entering. Selection of the right seal is all important, as is knowledge of slingers, shrouds, and other supplementary parts designed to help primary bearings do their job even better. Synthetic rubber seals. Combination seals. Large unit on lip-type seal. Installation and removal techniques.

S-104 T
Stair, W.K.
Liquid-Buffered Bushing Shaft Seals For Large Gas Circulators
Int.Conf.on Fluid Sealing, Paper C5 (14 pp.), April 17-19, 1961,
British Hydromechanics Research Assn., Harlow, Essex, England

The principles of hydrodynamic lubrication are employed in the analysis of liquid-buffered bushing shaft seals. The study includes the prediction of buffer fluid leakage, operating eccentricity ratio, and pressure drop across the seal necessary for satisfactory seal operation. It is shown that seal pressure drop cannot be established by an arbitrary specification of specific leakage rate.

S-105
Stair, W.K.
Bibliography on Dynamic Shaft Seals
Univ. of Tennessee, Engn. Exp. Sta. Dept. of Mech. Engng., 353 references (97 pp.), May, 1962 (Preliminary Issue)
References published through Dec., 1961.

S-106
Staller, J.J.
Oil Buffer Packing Gland - A153162
PB 36915, Off.Tech.Serv.(3 pp.), Jan., 1944
(Springfield Armory Eng.Dept. Tech.Rept. W0377)

Tests were made on various samples of packing glands for Cal. 50, M2 aircraft machine guns, using lengthened and standard dimension packings of Super Seal #7 material, and lengthened samples of Super Seal #3 material.

S-107
Staples, B.G.
Flexible Corrosion Resistant Plastic Solves Gasket Problems
Materials & Methods, V.32, pp.48-49, Dec., 1950

Teflon rings and tape prove good gasket and gasket protecting materials for use in chemical processing equipment.
Plastic is one of the most inert to chemical attack and can be used at temperatures up to 500°F, without decomposition, and at pressures to 300 psi.

S-108
Staples, B.G.
Gasketing Glass-Steel Equipment
Corrosion Technology, V.6, pp.151-152, May, 1959

Research conducted by Pfaulder Co. to develop suitable gasket designs that utilize materials that combine chemical resistance of glass with physical properties of rubber; recommendations for proper installation of Teflon-shielded gaskets; other methods of gasketing.

S-109
Starr, A.M.
Seal
U.S. Patent No. 2,442,622, June 1, 1948, to U.S. Atomic Energy Commission

Details and design of a rod extending into a vacuum chamber through a seal which, although leakproof, permits rotational, translational, and rocking motion of the rod.

S-110
Steckelmacher, W.
Seals and Gaskets for Ultra High Vacuum Systems
Vacuum, V.12, March/April, 1962

Seals which remain vacuum tight while being baked at high temperature to promote rapid degassing. Demountable joints have been made employing thin wires, solid rings of various shapes, and metal foil gaskets. The design of suitable flanges, shaped projections, and any associated springs are considered. Data are given of experimental results achieved with various seals covering a range of materials and dimensions.

S-111
Stephens, H.R.
High Pressure Teflon Seals and Closures
Plastics Tech., V.3, No. 2, pp. 113-114, Feb., 1957

Self-sealing principle is used to design packing rings and closures that provide excellent high-pressure seals; Teflon packing ring has been used in very simple self-sealing closure designed to hold 22,500 psi of pressure in 1-inch diameter chemical reaction vessel.

S-112 T
Stephens, J.A.
Properties of Rubber Seal Materials
Int. Conf. on Fluid Sealing, Paper F1, April 17-19, 1961
British Hydromechanics Research Assn., Harlow, Essex, England

A survey of various types used in manufacture of lip seals, and pertinent properties discussed. Strength and wear resistance, elastic recovery, stability at temperature extremes, and resistance to fluids of eight rubbers are compared. An opinion as to the significance of these properties is given.

S-113
Sterzer, F.
Simple High-Temperature Vacuum-Tight Mica Window
Rev. Sci. Instr., V.28, pp.208-9, 1957

A vacuum-tight mica seal was obtained by screwing together a thin sheet of mica and a flat annealed copper ring between two stainless-steel flanges.

S-114
Stevens, A.B.
Split Lantern Rings in Pump Packing Glands Reduce Oil Losses, Increase Life of Packing
National Petroleum News, V.38, R254, p. 2, April 3, 1946

S-115
Stevens, J.B.
Current Status of Axial Face Seals
SAE Jour., V.64, pp.46-50, Sept., 1956

Application of seals to aircraft gas turbine main shaft bearings, gear boxes or accessory pads and accessories; limitations with respect to sealing media, temperatures, pressures and rubbing surface speeds; influence of these factors on selection of materials.

S-116
Stevens, J.B.
Bellows Type Mechanical Seal
Mechanical Design, THE SEALS BOOK, pp.44-47, Jan. 19, 1961

The main function of the metal bellows in axial mechanical seals is to replace the static seal element. They are useful in special applications where an all-metal seal is necessary. These applications are generally those where high temperature is encountered or where the liquid or gases used would adversely affect organic seal materials. Metal bellows seals will operate from -400°F to + 1200°F. Sealing surfaces must be able to accept the thrust loads developed by the pressure drop across the seal. A maximum pressure drop of 1000 psi is reasonable.
Selection factors and their significance is covered.

S-117
Stevens, J.B., Greiner, H.F.
Factors In Designing for Mechanical Seal Applications to Hydraulic Equipment
Proc. National Conference on Industrial Hydraulics, V. VII, pp. 131-42, 1953

Thorough presentation of terms and classification; advantages and limitations of mechanical seals; balanced and overbalanced; materials for packing and their limitations, including Teflon, Kel-F, polyethylene.

S-118
Stevens, J.B. and Greiner, H.F.
Mechanical Seals for Hydraulic Equipment
App. Hydraulics, V.7, pp. 70-73, June, 1954

Design and application of eight types of mechanical seals for hydraulic equipment are covered. These are:
1. Jam packing rotary unbalanced seal.
2. "V" packing stationary balanced seal.
3. "V" packing stationary unbalanced seal.
4. O-ring rotary balanced seal.
5. Rubber bellows- rotary unbalanced seal.
6. Rubber diaphragm-stationary unbalanced seal.
7. Metal bellows-stationary balanced seal.
8. Piston ring-stationary balanced seal.

S-119
Stewart, W.L.
Designing and Testing Journal Box Seals
Lubrication, V.15, pp. 242-245, 264, June, 1959

Increased use of lubricating pads replacing cotton waste as lubricant medium on railway journal box showed notable increase in oil consumption; problems encountered in attempt to seal back end of journal box; factors to consider in design of railway sealing applications; details of equipment for testing seals designed to operate in standard 5-1/2 x 10 AAR journal box; standard test procedure consisting of six tests.

S-120 T
Stodla, A. (Translated by L.C.Loewenstein)
Steam and Gas Turbines
Sixth Edition, McGraw-Hill Book Co., Inc., New York, N.Y., V. 1, pp. 189-194, 1927

Review of Becker's analysis of flow through annular clearances, with graphical experimental results. For labyrinths, an equation similar to that of Martin is derived but in a different manner. In addition, modifications to the formula allow its use for radial labyrinths and critical flow. A graphical method which gives better accuracy for critical flow is provided. Experimental data are reported.

S-121
Storozhnik, A.A.
Hydraulic Seal of the Charge Distributor When Working at Elevated Top Pressure
British Iron and Steel Industry Translation Service
BISI-2238

Hydraulic seals, distributors, pressure.

S-122
Stott, T.C.
Some Notes on Synthetic Rubber Oil Seal Applications
Instn. Automobile Engrs., J., V.12, pp. 161-187, July-Sept., 1944

Automobile and kindred applications involving high surface speeds and very high standard of sealing performance. It is for these applications that the synthetic rubber seal is eminently suited. Notes deal principally with synthetic rubber seals running under such conditions, and are based on results of various investigations and tests.

S-123 T
Stratton, A.C.
Shaft Sealing Means
U.S. Patent 2,243,227, May 27, 1941

A mechanical face seal is actuated by means of a collar of rubber or neoprene with a "V"-shaped annular groove around its circumference. A garter spring in this groove tends to widen the rubber collar, forcing the rotating seal ring against the stationary seal face. The rotating seal ring is driven by friction with the rubber collar, which forms its own static seal with the shaft.

S-124
Straus, F.R.
Performance Cycling Test of High Temperature Hydraulic O-Ring Packings
PB-123720, Off. Tech. Serv., Project 1371, Task 13495, AF WADC TN WCLS 54-71

Description of methods used to determine the mechanical performance of synthetic O-ring packings in hydraulic fluids at temperatures up to +500°F.

S-125
Straus, F.R.
Evaluation and Testing of Hydraulic O-Rings
Included in WADC Tech.Rept. 57-478, Elast. for Air Weapons, WADC University of Dayton Joint Conference, Oct., 1957

S-126
Straus, F.R.
Development of O-Rings for Aircraft Application
Applied Hydraulics, V.6, pp. 82, 84, 86, 114-5, Aug., 1953

Design of early aircraft O-rings; military specifications issued in 1942; development of compounds for use in molding O-rings; functioning of O-ring compounds down to -40°F was proved in 1942-1943 cold weather operational tests; development of hydraulic packings in the last 10 years; present-day specifications.

S-127
Streck, F.O.
Performance Test of a Two-Coolant Retention Sodium Pumpshaft Freeze Seal
Atomics International Dev., North American Aviation, Inc., Canoga Park, Calif., NAA-SR-Memo. 4119 (15 pp.), July 15, 1959

The operation of the freeze-seal type sodium pump requires a shaft freeze-seal capable of retaining sodium. Test characteristics noted.

S-128 T
Strickland, H.R.
Bearing and Seal Assembly for Turbines
U.S. Patent 2,496,897, Feb. 7, 1950

Labyrinth seal and bearing assembly which may be installed and removed axially with the rotor in place. The radial labyrinths are of such design that longitudinal expansion of the rotor has no effect.

S-129
Strohm, R.T.
Metallic Packings
Am. Elect'n., Oct., 1905

States the advantages of metallic packings, and illustrates and describes several forms.

S-130
Stubenrauch, E.H.
Getting The Most Out Of Gaskets
Chemical Engineering, V.69, pp. 123-128, Sept. 3, 1962

Materials discussed: Teflon, Armalon, Viton, silicone, metal fiber composites, compressed asbestos, woven and folded asbestos cloth, rubber, vegetable fiber, and metals. Applications of various metal gaskets and six designs for metal gaskets are tabulated.
Flange design and surface finish for proper sealing of gaskets includes table of five basic types of gasketed joints with characteristics and suitable types for each.
Also discusses bolting procedures, seal maintenance, and changing of gaskets.

S-131 T

Summers, A.B.
Multi-Disk Floating Contact Mechanical Shaft Seal
U.S. Patent 2,711,914

This invention uses the sealed shaft to drive a number of gears of decreasing size. These driven gears in turn drive floating gears mounted on the shaft or shaft collar. Sealing disks between the driving shaft, and adjacent floating gears, and the housing effect the seal. By suitable ratios and varying the number of gears, any maximum speed between sealing elements may be held.

S-132 T

Summers-Smith, D.
Laboratory Investigation of the Performance of a Radial Face Seal
Int. Conf. on Fluid Sealing, Paper D1 (12 pages), April 17-19, 1961
British Hydromechanics Research Assn., Harlow, Essex, England

The performance of a radial face seal in terms of leakage, wear and friction torque in a rig in which the liquid pressure and contact loading of the seal face could be varied independently. Sealed water at pressures up to 50 psi. Friction and wear measurements indicate that for normal operation a fluid film (approx. 100 micro-inches thick) is generated between the sealing faces.

S-133

Sussman, S.
Mechanical Shaft Seals
Air Cond., Heat. & Vent., V.57, pp. 61-66, July, 1960

Factors governing use, performance, and failure of seals which incorporate two rings which have their faces at right angles to pump shaft; examination of their application to open spray and closed circulating systems.

S-134

Swartz, J.H.
Nonmetallic Diaphragms
Machine Design, V.20, pp. 153-8, 206, June, 1948

Chemical and physical properties of rubber and other diaphragm materials; design considerations; various applications such as pressure regulators, control valves, and accumulators.

S-135

Swartz, J.H.
"O" and "V" Ring Packings in Industrial Hydraulics
Proceedings of National Conference on Industrial Hydraulics, V.IV, pp. 251-269, 1950

Thorough coverage, including: historial background, the Rapieff joint, function of packings, "V" ring packing, fabric "V" ring packing, vee-dam packing, homogeneous "V" rings, O-ring packing, design data, dynamic O-rings, static O-rings, and material selection.

S-136

Swearingen, J.S.
Know Your Mechanical Seals
Chem. Eng., V.62, pp. 213-16, 1955

The factors which govern the choice between types of mechanical seals for rotating shafts, or between seals and stuffing boxes, are discussed.

S-137

Swartz, J.H.
Design Recommendations for O-Ring Seals
Product Eng., V. 22, pp. 162-3, Sept., 1951

Drawings and test concerning: type of groove, groove dimensions, external and internal grooves, poor and good practice, face seal groove, plug seal, check valve seal. Table of dimensional data for standard AN or JIC O-rings and gaskets.

S-138

Sweikert, M.A. and Johnson, R.L.
Wear of Carbon Type Seal Materials With Varied Graphite Content
Am. Soc. Lubrication Engrs. Trans., V. 1, No.1, pp. 115-120, April, 1958

Study to determine influence of increased graphitic carbon content on wear and friction of carbon bodies used in sliding contact seals of turbine type aircraft engines; bodies molded with high graphite content materials and hardened by improved methods gave acceptable friction and wear properties, using hardenable stainless steel; effect of varied hardness of mating surface on wear of typical carbon was slight.

S-139-

Swota, John, Jr.
Compression Load Cell for Measurement of Seal Compression Forces
Nuclear Science Abstract- 19011 (KAPL-M-JOS1)
Cont. W-31-109-Eng.52
(Knolls Atomic Power Lab., Schenectady) (8 pp.), Mar. 12, 1962

A load monitoring device was incorporated into a Conax seal test fixture, and a test procedure was developed to determine the relationship between applied torque and the resulting compression load impressed on Teflon seals as a function of various design parameters such as follower configuration and lubrication effects. Periodic calibration indicated that load values are accurate to within $\pm$ 0.5% of full load values.

S-140

Symons, J.D.
Engineering Facts About Lip Seals
SAE Automotive Eng.Congr., Detroit, Mich., preprint 473A (14 pp.), Jan. 8-12, 1962

Description of a test program for the study of oil seals. Causes of seal leakage are investigated, and some design criteria are established.

S-141

Symons, J.D.
Lip Seals, Performance and Design Factors
Machine Design, V.34, No.5, pp. 148-154, March 1, 1962

This article discusses the friction of rubber seal materials with special attention to shaft surface finish and machine lead, modulus of seal material, corrosion of steel shafts by various elastomers, quality control specification, and economic aspects. Test details, data, curves, etc.

S-142

Symons, J.D.
Lip Seal Failures Can Be Reduced
SAE Jour., V.70, pp. 74-77, May, 1962

Studies surface finish of the shaft material upon which the seal lip rides to reduce friction and seal-shaft interface temperature. Also studies corrosion of the steel shaft by the lip-seal material.

T-001 B

Taber, R.A., and Robbins, F.A.
Teflon Based Piston Rings For Non-Lubricated Applications
Mechanical Engineering, V. 79, No. 9, pp. 834-41, Sept. 1957

Comparison of K30 material, consisting of Teflon and fine glass fibers; with cotton fabric and resin plus graphite; cotton fabric with resin plus molydisulfide; asbestos fabric and resins; glass cloth fabric with epoxy resin; both laminates and moldings.
Tables of wear test and material properties are presented.

T-002

Tangerman, E.J.
Design Proportions For "U" Leather Packings
Product Eng., V. 6, pp. 224-6, June 1935

Packing friction, stuffing-box design and packing proportions for one of four types of commonly used leather packings for light and heavy pressures for both hydraulic and pneumatic service.

T-003

Tankus, Harry
Axial Mechanical Seals
Machine Design, The Seals Book, pp. 32-42, Jan. 19, 1961

Axial mechanical seals (end face seals) form a running seal between flat, precision finished surfaces. Have been used for pressures up to 3000 psi in heavy duty process pumps and for speeds exceeding 50,000 fpm and temperatures above 500°F.
General purpose axial pump seals are discussed, as is the metal-bellows mechanical seal. The latter is used for extreme temperature service and where other types of static sealing elements cannot be used effectively.
Main advantage - low leakage
Main disadvantage - requires careful handling and installation.

T-004

Tanner, R.I.
Non-Newtonian Flow And The Oil Seal Problem
Jour. of Mech. Engng. Sci., V. 2, pp. 25-28, March 1960

Difficult to explain the action of oil seals if the fluid is regarded as Newtonian. Possible hypothesis is that the fluid, when subjected to extremely high shear rates, behaves in a non-Newtonian manner, utilizing a fairly general stress-strain rate relation. A simplified analysis of the seal problem is given. Comparison with the currently available experimental work shows that non-Newtonian effects are not likely to provide a complete explanation of the oil-seal problem.

T-005 T

Tanner, R.I.
The Reiner Centripetal Effect In Face Seals
Int. Conf. on Fluid Sealing, Paper E1 (5 pp.), April 17-19, 1961, British Hydromechanics Research Assn., Harlow, Essex, England

Two possible explanations for inflow against centrifugal force in seals have been advanced. One assuming nonperfect geometry of the sealing surfaces and the other non-Newtonian behavior of the sealing liquid. A review of the literature and order of magnitude calculations establishes the fact that non-Newtonian effect is likely to be insignificant in many practical cases. At the present time, inflow seems best explained by vibration and wobble of seal surfaces.

T-006 T

Tao, L.N., Donovan, W.
Through-Flow In Concentric And Eccentric Annuli Of Fine Clearance With And Without Relative Motion Of Boundaries
ASME Trans., V. 77, pp. 1291-1301, 1955

Derives theoretical flow equations for title conditions. Certain assumptions by authors questioned in discussion by Teichmann. Experimental data, in good agreement with theoretical equation, are presented in graphical form for Reynolds' numbers up to 30,000. Thermal effects, phase change, and compressible flow are not included.

T-007

Taplin, J.R., and Phillips, J.J.
Diaphragm Seals
Machine Design, The Seals Book, pp. 77-82, Jan. 19, 1961

A diaphragm is a dividing membrane. It spans the gap between a moving and a stationary member to prevent interchange of a fluid or gas between two separate areas or chambers.
Three classes: 1. Separating membrane - no pressure differential exists between chambers. 2. Static diaphragm - separator, little or no motion. 3. Dynamic diaphragm - acts as sealing device between stationary and moving members, usually transmits a force or pressure.
Made of cotton, Dacron, Nylon, Teflon or glass. Depending on choice of material, temperatures up to 700°F are possible.

T-008

Tapsell, H.J.
Pipe Flange Research Committee, Second Report
Proc. Instn. Mech. Engrs., London, V. 141, pp. 433-71, and V. 142, p. 397, 1939

Research has continued to follow the original program with one addition: the relating study of creep relaxation of model flanges. The present report deals with the following sections of work: an investigation of conditions on the joint under which tightness is maintained at room temperature; investigation of behavior of compressed asbestos packing material; the completion of the examination of the properties of the materials used in the bolt assembly tests; experiments on full-scale bolted flange joints under conditions of high temperature and pressure; and creep relaxation tests on model flanges.
Curves, drawings, data tables.

T-009

Taschenberg, E.J., and Pennington, J.W.
Piston Rings For Hydraulics
App. Hydraulics, V. 8, pp. 67-70, 120, Nov. 1955

Basic information on the development of metallic sealing rings. Effective use of the proper sealing ring also requires consideration of dimensions and finishes of the hydraulic cylinders and pistons.
Most commonly used ring material is a high grade cast iron. For applications where lubrication is poor or certain corrosive conditions exist, bronze rings are frequently used. For high temperature applications, stainless steel, Ni-Resist or a high grade chromium cast iron is indicated.

T-010
Taschenberg, E.J.
Evaluation Of Design And Materials For High Speed-High Temperature Shaft Seals For Turbojet Engine Applications
WADC Tech. Report 56-267, ASTIA Document No. AD110636 (65 pp.), May 1956

A large number of materials were investigated to determine those having promising wear characteristics at room temperature and at high temperature. Shaft seal design was reviewed with respect to the adaptability of such new materials to the several designs incorporating these materials.
Design and construction of seals to operate at 200 psi, 1,000°F, and 30,000 rpm.

T-011
Taschenberg, E., and Pearson, W.
Circumferential Seals
Machine Design, The Seals Book, pp. 48-50, Jan. 19, 1961

Circumferential seals are high performance, low leakage, contact type seals for use in critical applications. Undergoing high-velocity rubbing at their primary seal surfaces, the seals offer a high order of sealing ability and accommodate unlimited relative axial motion between stationary and rotating members.
Circumferential seals described are sophisticated versions of the reciprocating rod and piston seals.
Carbon is the commonly used material.
Compressible fluids are most commonly used with these seals.
Upper limit 1000°F.

T-012
Taylor, G.I.
Stability Of A Viscous Liquid Contained Between Two Rotating Cylinders
Phil. Trans. Royal Soc., London, Series A, V. 223, pp. 289-343, 1923

First a review of previous work in flow stability by ten authorities. From general equations representing symmetrical disturbances for the case of incompressible flow between two rotating cylinders, a stability criterion is developed. Extensive experimental results, and pictures of turbulent flow conditions are presented.

T-013 T
Taylor, G.I.
Fluid Friction Between Rotating Cylinders
Proc. Royal Soc. of London, Series A, V. 157, pp. 546-564, 1936

Torque measurements were made for two general cases of concentric rotating cylinders: inner cylinder rotating with outer cylinder fixed and outer cylinder rotating with inner cylinder fixed. Critical speeds were lower for the first case. Several fluids were used, and the diameter of the inner cylinder was varied.

T-014 T
Taylor, G.I., Saffman, P.G.
The Effects Of The Compressibility At Low Reynolds Number
Jnl. Aero. Sci., V. 24, No. 8, pp. 553-562, Aug. 1957

The authors are concerned chiefly with explaining the results and disproving the hypothesis of Reiner, who noted a positive pressure of 0.5 atmosphere at the center of two smooth discs with one disc rotating at 7000 rpm with near zero clearance. Reiner stated this pressure was due to non-Newtonian properties of air. Authors believe the pressure must be due to longitudinal vibration, errors in perpendicularity of either axis to the rotating plane, or roughness. Experiments which support their conclusions are described.

T-015 T
Taylor, I.
Seal-Oil Systems For Refinery Centrifugal Pumps
Petroleum Refinery, V. 22, No. 3, pp. 68-72, March 1943

Reviews various methods whereby an individual pump is sealed, and discusses briefly the ways in which problems are overcome.

T-016 T
Taylor, I.
Alkylation Unit Pumping
Petroleum Refinery, V. 23, No. 8, pp. 283-289, August 1944

This article discusses the pumping problems of alkylation units in general, and the shaft sealing problems in particular.
Single mechanical seals are recommended for light hydrocarbons; packings or double mechanical seals, seals for concentrated acids. Double mechanical seals for mixtures of acids and hydrocarbons.

T-017
Teucher, S.
Cylinder Head Gasket
Automobile Eng., V. 52, pp. 298-303, Aug. 1962

T-018
Thayer, H.H.
Packing And Gaskets For Shipbuilding Purposes
Marine Engineering, V. 27, pp. 720-2, Nov. 1922

Packing of moving parts: assembled metallic packings; metallic packings, misc.; soft packing.
Packing of stationary parts: gaskets, metallic; compressed asbestos fibre; woven asbestos cloth; rubber; rubber compositions; wood fiber.
Boiler gaskets: misc. packings, canvas, corset lacing, tar felt, cup leather, paste jointings.

T-019
Thomson, J.L.
Packed Glands For High Pressures: An Analysis Of Fundamentals
Institution of Mechanical Engineers, Proc., V. 172, pp. 471-486, 1958

Recognizing the uncertain manner in which a seal is effected in a packed gland, and the numerous factors involved, the development of even an approximate theory is indicated.

T-020 T
Thomson, J.L.
A Theory Of Sealing With Particular Reference To The Packed Stuffing Box
Int. Conf. on Fluid Sealing, Paper B1, British Hydromechanics Research Assn., Harlow, Essex, England, April 17-19, 1961

After making the assumption that the relationship between the contact stress and pressure gradient in the stuffing-box seal is linear, it is shown that contact stress increases exponentially and fluid pressure decreases exponentially with distance. With modification, the same principle is applied to the O-ring seal. The influence of contact stress on wear and friction is then considered.

T-021
Thomson, W. E.
High Turbine Vacuum By Attention To Packing
Electrical World, V. 80, p. 490, Sept. 2, 1922

Discussion of methods of obtaining good vacuum:
1) Attention to the carbon packings - primary cause of low vacuum,
2) Turbine starting procedure,
3) Look for air leaks in turbine casing,
4) Check carbon packing spring.

T-022
Thoren, T.R.
Sealing Aviation Fuel System Equipment
Mech. Engng., V. 66, pp. 663-667, Oct. 1944

Synthetic rubber seals satisfactory for sealing aviation fuel-system equipment. Introduction of aromatic blended aviation fuels and requirements of operation down to -65°F required alteration of seals, both in construction and rubber composition.
Manufacturers of aviation fuel-system equipment have made extensive programs of testing to evolve seals now in construction. Paper covers these, specifically for fuel booster pumps, selector cocks, and engine driven pumps.

T-023
Thorn, F.C.
Gaskets
Ind. & Engng. Chem., V. 28, pp. 164-170, Feb. 1936

An attempt is made to classify gasketed joints by types, and to indicate the materials and construction employed in modern gaskets for various types of joint and for the various fluids handled through these joints.

T-024
Thorn, F.C.
Packing Centrifugal Pump
Indus. & Eng. Chem., V. 31, pp. 929-33, Aug. 1939

Attempt made to present case of packing manufacturer; although remarks are applicable primarily to centrifugal pump, many of them are equally true of rotary displacement and turbo pumps, and to other stuffing box applications involving rotary shafts. Drawing showing various packings.

T-025
Thorn, F.C.
Performance Of Centrifugal Pump Packing
Power Plant Engng., V. 45, pp. 80-81, Sept. 1941, pp. 67-69, Oct. 1941

Power plant operator has two ideals in mind, no leakage and no friction. Article covers test methods devised for determining quantitatively what the balance between these two factors should be as applied to centrifugal pumps.
Packing rings cut from braided asbestos coils, with butt joints.

T-026
Thorn, F.C.
Sealability Of Gasketing Materials On Smooth And Wavy Flanges
ASTM Bul, No. 203, pp. 43-44, Dec. 1955

Results of tests on subject matter indicated for three 1/16" gasket materials; red sheet, cork paper with glue-glycerine binder, and compressed asbestos sheet.

T-027
Thorness, R.B., Nier, A.O.
All Metal Valve For Ultra-High Vacuum Use
Rev. Sci. Instrum. (U.S.A.), V. 32, No. 7, pp. 807-10, July 1961

A demountable solderless all-metal valve suitable for ultra-high vacuum applications is described. A gasketed stainless steel diaphragm transmits the motion. One modification is useful for providing a straight path for passage of a beam of particles or light between chambers which it may be necessary to evacuate separately. A group of valves, machined from a single block may form a complete manifold. The basic mechanism has also been employed for transmitting motion in a high vacuum system; for example, adjusting a slit.

T-028
Tilbe, H.E.
Operation Of A 1200 U.S.G.P.M. Shaft Seal Pump At 1050 PSIA And 500°F
R58CAP10 Tech. Report, Canadian Gen. Elec. Co., Ltd.,(17 pp.), Feb. 7, 1958

Data are presented of shaft seal performance during the development period of a large shaft seal pump. Pump design modifications necessary to obtain satisfactory performance from seals are described. Total leakage rates since pump modifications have averaged 1 imperial gallon per day per seal. Operation and maintenance data of the seals is given.

T-029 B
Tipton, F.W.
Design Data For O-Rings And Similar Elastic Seals, Part I
WADC Tech. Report 56-272, (104 pp., 15 fig., 12 tab), Nov. 1956, (PB 121898) (Off. Tech. Ser.)

One of three reports describing work of Boeing Airplane Company under U.S.A.F. contract to determine relationship between physical properties of the seal materials and behavior of the complete seal. No definite relationship was found. The test related to static, rotating and reciprocating shafts.

T-030 B
Tipton, F.W., Trepus, G.E., and others
Design Data For O-Rings And Similar Elastic Seals, Part III
WADC Tech. Report 56-272, (88 pp., 39 fig., 19 tab), April 1958, (PB 131902)

One of three reports describing work of Boeing Airplane Company under USAF Contract. Determine relationship between physical properties of the seal materials and behavior of the complete seal, but no definite relationship was found. The test related to static, rotating and reciprocating shafts.

T-031
Tipton, F.W.
Design Handbook For O-Rings And Similar Elastic Seals
WADC Tech. Report 59-428, (60 pp.), October 1959

A summation of work done under Air Force Contract AF 33(616)-2867 and AF 33(616)-5722. It is presented in the form of a handbook covering the mechanism of O-ring sealing, the relation of physical properties to sealing, the effect of cavity configuration, back-up rings and adverse mechanical conditions on seal life, and the design of seals for specific systems. It also contains test procedures and a bibliography of published articles pertinent to O-ring seals.

T-032
Tisch, R.E.
Friction Study Of Hydraulic Seals
WADC Tech. Rept. 55-228, June 1955

T-033
Todd, H.E., Miazga, J.F.
How To Compound Silicones For Seals
SAE Journal, V. 67, p. 106, June 1959

Brief discussions of compounds of 60-70 durometer hardness, compounds containing precipitated silica as a filler. Compounds with fumed silica fillers, diatomaceous silica fillers, ditertiary butyl peroxide as the best of catalysts for low compression, and the pronounced effect of heat on virtually all the properties of silicone rubber compounds.
Parts of paper No. 50V.

T-034
Todd, H.E., and Miazga, J.F.
Properties Of Silicone Rubber For High Temperature Static Seals
SAE Transactions, V. 68, pp. 224-231, 1960

Investigation of silicone rubber compounds for static seal applications demonstrates the importance of tests to evaluate these materials for specific properties and at environmental temperatures which simulate anticipated service requirements. Relationships established between these properties and compound composition; presented as guide for selection of suitable materials for specific seal applications. Maximum temperature of 500°F indicated.

T-035
Toepel, R.R.
Designing Lip Seals For Long Service Life
SAE Journal, V. 70, p. 92, March 1962

Discussion of lip seal design for rotating shafts for automatic transmission, particularly the two main seals. Includes factors in design and application, solving the OD problem, shaft requirements.

T-036
Toffer, H., Amrein, R.L.
Plastic To Metal Vacuum Seal For Rotating Targets
Review of Scientific Instruments, V. 31, pp. 348-9, March 1960

T-037 T
Tourret, R.
Notes On The Development Of Roots-Type Cabin Superchargers
Royal Aircraft Establishment Tech. Note No. SME379, October 1946

A seal described in this report, called a Rotol seal, makes use of a viscosity screw pump in conjunction with a pair of labyrinth seals. The seal, which is of the contactless type was virtually 100 percent oil tight.

T-038
Towler, F.H.
Reciprocating Seals
The Engineer, V. 187, p. 229, February 25, 1949

Working conditions encountered by reciprocating seals compared with those of rotary seals, the mechanism of the automatic seal under static conditions of motion and friction, packingless pistons, and J.F. Stewart's shaft hydraulic seal for aircraft pumps. Diagrams and figures.

T-039
Towler, F.H.
Reciprocating Seals
IME Proc., V. 160, pp. 536-540, 1949

Various types of reciprocating seals are discussed; hemp, leather, rubber, piston rings, and O-rings; conditions for proper operation.
Pressures from 500-10,000 lbs. per sq. inch are indicated.

T-040
Towlson, J.T.
Frictionless Metallic Packing
Power, V. 70, p. 257, Aug. 13, 1929

Original packing box ground out, bronze rings inserted. Precludes the possibility of the packing box being a guide for the piston rod. Dispenses with all kinds of adjustable packing and split rings.
Drawing is presented; assembly and operation discussed in detail.

T-041
Tracy, H.
Improper Suction Piping Can Knock Out Mechanical Seals In Short Order
Power, V. 106, pp. 160-1, July 1962

Poorly designed suction piping can do a lot of damage. Example presented. Pump handling propane at 100°F. Pressure differential of 285 psig.
Drawing and detailed description.

T-042
Tracy, H.E.
Select Best Pump Seal
Chem. Eng., V. 64, No. 4, pp. 239-254, April 1957

Centrifugal pump leakage devices can be divided into zero leakage types and controlled leakage techniques; recommended methods for preventing or eliminating leakage of hydrocarbons, water, chemical solutions, molten metals, and liquid gases at various temperatures and pressures; use of mechanical seals, throttle bushing, floating rings, and canned pumps; materials of construction are discussed only as materials are affected by pressure and temperature.

T-043
Treiber, K.L.
Hydraulic Problems Encountered During The Development Of Corps Of Engineer Equipment
Proc. National Conference on Industrial Hydraulics, V. 8, pp. 5-24, 1954

A detailed description of two mechanical seals used on two stage and four stage portable pumps (In the panel discussion by V.E. Vorhees).

T-044 B
Trepus, G.E.
Design Data For O-Rings And Similar Elastic Seals, Part II
W.A.D.C. Tech. Report 56-272, (106 pp.), Sept. 1957

One of three reports describing work of Boeing Airplane Company under U.S.A.F. contract to determine relationship between physical properties of the seal materials and behavior of the complete seal. No definite relationship was found. The test related to static, rotating and reciprocating shafts.

T-045
Trepus, G.E., Roper, R.S., Hickman, W.R.
Design Data For O-Rings And Similar Elastic Seals
WADC-TR-56-272, Part IV

Continuation of the study initiated under Air Force Contract AF 33(616)2867. The purpose of this study was to determine design criteria for O-rings, back-up rings and other elastomeric seals.

T-046
Trepus, G.E., Roper, R.S., Hickman, W.R.
Design Data For O-Rings and Similar Elastic Seals
WADC Tech. Rept. 56-272, Part V

Continuation of a study initiated under Air Force Contract AF 33(616)-5722. The purpose of this study was to determine design criteria for O-rings, back-up rings and other elastomeric seals.
Seals for use in cryogenic systems,
Effects of ozone on elastomeric seal materials,
Literature review of age control techniques,
Abstracts.

T-047
Trevoy, D.J., and Torpey, W.A.
Shaft Seal For Vacuum Apparatus
Anal. Chem., V. 24, p. 1382, 1952

A shaft seal is constructed of a 0.081 in. drill rod matched to a precision capillary tube of the same nominal diameter.

T-048 B
Troyan, J.E.
Hints For Plant Start Up - Part III - Pumps, Compressors, And Agitators
Chemical Engineering, V. 68, pp. 91-4, May 1, 1961

Typical problems arising from the use of mechanical seals, with emphasis on lubrication, are discussed in a part of the article. The author also considers stuffing boxes and packings.

T-049
Trummel, J.M.
Irradiation Test Of Static Buna - N O-Ring Seals
Oak Ridge National Lab. Tenn., CF-54-8-226
Contract W-7405-Eng-26, Aug. 25, 1954, Decl. Feb. 20, 1956

The object of this test was to determine the life expectancy of four groups of Buna-N O-ring oil seals under gamma irradiation. These static seals were used to seal Gulfspin 60 oil at 75 psi pressure differential at about 125°F in a test arrangement placed in the flux of low intensity testing reactor. Test results noted.

T-050
Trutnovsky, K.
Labyrinth Slits In Piston Engines (In German)
Forschung aud dem Gebiete des Ingenieurwesens, V. 8, pp. 131-43, May-June 1937

Usual packings discussed and apparatus described for investigating losses in new form of packing; characteristic size of labyrinth slit was modified to measure influence of these modifications on losses; example of calculating losses in advance by means of formulas for flow in tube; advantages of labyrinth slits.

T-051 T
Trutnovsky, K.
Labyrinth Packing (In German)
VDI-Zeitschrift, V. 83, No. 29, pp. 857-858, July 22, 1939

The advantages of labyrinth seals in high pressure and high temperature applications are discussed. Characteristics of this type of seal in comparison with other types are shown. This report lists 16 references.

T-052
Trutnovsky, K.
Design And Action Of Stuffing Boxes (In German)
VDI Zeit., V. 85, pp. 383-7, April 19, 1941

Causes of leakage; methods and means for eliminating leakage are shown in schematic drawings; special attention paid to materials requiring no lubrication; data on leakage and friction losses and packing dimensions.

T-053 T
Trutnovsky, K.
Contactless Seals (In German)
VDI, Verlag, Berlin 1943, Published by authority of the Alien Property Custodian Under License No. A828 by J.W. Edwards, (155 pp.), 1943

This book, which includes 72 references, discusses theory, design, and construction details of clearance seals and labyrinth seals. This complete study of contactless seals is the only book which has been found entirely devoted to this subject. Dynamic seals and buffered bushing seals are briefly discussed.

T-054 B
Trutnovsky, K.
Research On Labyrinth Glands (In German)
D.I.Z., V. 101, No. 18, pp. 752-5, June 21, 1959

This paper summarizes recent work in Germany on labyrinth seals as used in steam turbines. It appears that little can be gained by using conical shaft discs and housing grooves in axial seals. A simple arrangement using radial discs and rectangular ones having a depth, width and pitch of 3, 5.5, 8 mm gives a good performance clearance of 0.38 mm.

T-055
Turnbull, A.H.
Vacuum Techniques For Beginners
A.E.R.E. - Rep. No. G R 752 - 23.8.51, (UK Atomic Energy Research Establishment Report)

An introduction to vacuum technique written for the engineer who wishes to familiarize himself with the working principles and operating conditions of a vacuum plant. The following subjects are covered: rotary pumps, diffusion pumps, pump matching, types of gas flow, vacuum measurements, vacuum components, vacuum unions, shaft seals, vacuum flanges, vacuum valves, vacuum grease, wax, etc.

T-056 B
Turnbull, D.E.
The Sealing Action Of A Conventional Stuffing Box
British Hydromechanic Research Association, RR 592, (16 pp., 16 fig.), July 1958

A brief review of previous work on the frictional properties of various soft packings. Definitions are suggested. Several non-dimensional parameters are described. A choice is made of an approximation to the friction characteristics. Using this, the theoretical axial pressure distribution along a packing is calculated. Experimental data and analysis.

T-057 B

Turnbull, D.E., Nau, B.S.
Some Effects Of The Elastic Deformation Of The Sealing Rings Of A Mechanical Or Radial Face Seal On Its Sealing Behavior
British Hydromechanic Research Association, RR 644, (5 pp., 9 fig.), Feb. 1960

This report examines the effect of elastic deformation of the faces of a radial-face seal. It is shown that at pressures of the order of 1000 lb/sq. in. the local deformation is several times greater than the usual thickness of the oil film and this is liable to give rise to prohibitive leakage rates. A possible method of overcoming this effect is described.

T-058 B

Turnbull, D.E., Nau, B.S.
A Simplified Analysis Of The Characteristics Of Fabric-Rubber Seals For Reciprocating Shafts
British Hydromechanic Research Association, RR 648, (5 pp., 7 fig.), Feb. 1960

T-059

Turnbull, J.C.
Tension Stresses In Glass Coatings And In Glass-Metal Seals In The Annealing Range
Amer. Ceram. Soc. Jour., V. 41, No. 9, pp. 372-376, Sept. 1958

Strength of glass coatings applied to metals decreases with time at temperatures in the lower annealing range. This is caused by decrease in the volume which glasses undergo. Tension strains are thus produced in directions parallel to the surface. In this temperature range, the production of tension stress due to density increase is partly offset by stress release due to viscous flow. Significant tension stresses of similar origin were observed to appear in glass - metal seals during baking in the lower annealing range.

T-060 B

Turton, D.F.
Eliminate Trapped Oil To Increase Packing Life
Applied Hydraulics and Pneumatics, V. 11, No. 11, pp. 101-2, Nov. 1958

Trapped oil between two seals back to back, can result in poor packing performance.
Design precautions taken to prevent this.
Some common failings, and examples of wear.

U-001

Ubbelohde, A.R.
Pyrolitic Graphite
Elec.Rev , V.170, pp.91-92, Jan. 19, 1962

Has remarkable thermal, mechanical and electrical properties. Because of the marked preferred orientation of crystallites, there is pronounced antistrophe in directions parallel and perpendicular to the plane of deposition. Co-deposition of carbon with other atoms, such as boron, may extend even further the technical applicability of these new pyrolitic materials.

U-002

Ullman, J.R.
Commercial Seals as Seats in a Bakeable Valve
Am.Vac.Soc., Trans. Eighth Nat.Vac. Symposium, Second International Congress, V.2, p. 1323, 1961

A simple bellows-sealed 3-in. valve is described which is based on the commercially available "Marman Conoseal" tube joint for the gate seat. The application is evaluated and the valve operating characteristics are given for the test valve, which gave leakage conductance of 10^{-6} to 10^{-10} atm/cm^3/sec for air.

U-003

Underwood, C.A. and Darnell, J.R.
Gaskets and Packings and How to Use Them
Power Plant Eng., V.27, pp.813-6, Aug. 15, 1923

Proper packings to be used on high and low pressure steam reciprocating engine shafts; combinations of duck, rubber and asbestos make good low pressure packings.

U-004

U S. Aeronautical Board (with amendment 2 July, 1946)
Hydraulic Packing Rings (Backup)
PB 40299, Off.Tech.Serv.,(9 pp.), May, 1945

These back-up rings of leather are intended for use with hydraulic O-rings operating at pressures up to 3000 psi and at temperatures up to 71°C (160°F). Materials and workmanship, detail requirements, methods of sampling, inspection and test are specified.

V-001
Van Heerden, P.J.
Metal Gaskets for Demountable Vacuum Systems
Rev.Sci.Instrum., V.26, No.12, pp. 1130-1, Dec., 1959

Two different constructions of copper gasket seals were investigated for a demountable vacuum system. They were 5 1/2 inches in diameter, and for both a leak rate lower than 10^{-6} microliter/second could be obtained.

V-002
Van Koppen, G.M.
A Metal Vacuum Valve
Appl.Sci. Research, B3, V.141, 1953

A 3-way valve with O-rings for all seals is described. After 5000 revolutions, the O-rings did not need replacement.

V-003
Van Wicklin, W.A.
Lincoln Power Steering Gear
National Conf. on Industrial Hydraulics, V.12, pp. 67-82, Oct., 1958

Discussion on seals, power cylinder seals, cover seals, shaft seals. "D" ring of 70 durometer synthetic rubber. O-ring seal. Brief general discussion.

V-004 B
Vermes, G.
A Fluid Mechanics Approach to the Labyrinth Seal Leakage Problem
Trans. A.S.M.E., V.83, pp.161-9, April, 1961

The paper describes investigations of labyrinth seals carried out recently; derives new theoretical, and semi-theoretical formulas for computation of the leakage which agrees within 5 percent with the tests for three different types of seals; off design performance of the seals is treated theoretically and experimentally

V-005
Vermes, G.
Leakage Flow in Straight Labyrinth Seal, Nomograph
Power, V.106, p. 62, January, 1962

This nomograph is based on "A fluid mechanics approach to the labyrinth seal leakage problem," Transaction ASME-Journal of Engineers for Power, April, 1962.
It gives the leakage flow, lbs. per sec., of a seal with N sealing points, spaced 5 inches apart, with a radial clearance C, around a straight shaft. Equations given.

V-006
Vermes, G. and Hahn, R.M.
New Approach to Labyrinth Seal Analysis
Allis-Chalmers Elec.Rev., V.25, No.4, pp. 24-25, 1960

Minimizing steam leakage through the shaft seals of a turbine has provoked studies and investigations for more than 50 years. Higher pressures and reduced space have aggravated this problem. It has been found that fluid mechanics provides more precise solutions to seal problems, resulting in greater simplicity and increased seal efficiency. Approach applicable to steam turbines, gas turbines, compressors, blowers, etc.

V-007
Victor, J.B.
Gaskets: Their Functions, Application, and Design
Product Engng., V.1, pp. 274-275, 283, June, 1930

A 3-page article on various materials that are used for gaskets such as paper, cork, rubber, asbestos, corrugated metal and metal-enveloped asbestos; their design and application.

V-008
Vieweg, Capt. W.V.R., Brown, F.W.
The Design of O-Ring Seals for Rockets
Tech. Memo. No.1046, U.S.Naval Ord. Test Sta., China Lake, Calif., March 17, 1956

V-009
Vitale, J.A.
Report on High Pressure Gasket Test
MIT Laboratory for Nuclear Science and Engineering Technical Report No. 1, (NP-1039) (7 pp.), Feb. 1, 1947

A gasket arrangement suitable for high-pressure work was developed and tested as applied to a high-pressure cloud chamber. A satisfactory gasket scheme for this application must be as nearly leak-proof as possible at 3000 psi, even when the initial or tightening pressure is relaxed due to deflection, be easily assembled, not require too close machining tolerances, and not be very position sensitive. The pump used was a standard hydraulic jack of 5-ton capacity.

V-010 T
Vogelpohl, G.
Contributions to the Knowledge of Bearing Friction (In German)
VDI-Forschungsheft, No.386 (28 pp.), 1937

On the basis of experiments, the author concludes that cavitation in a journal bearing is a function of the clearance diameter rates, viscosity and shaft speed. When the relative clearance is low, the cavitation will occur at lower speeds. Oil cavitation differs from water cavitation. Treated oil (degassed) results in less cavitation. The observations by the author may be of value in study of cavitation and/or gas release in buffered bushing seals.

V-011
Von Maur, J.D.
Use of Rubber Gaskets for Joint Making Purposes
American Gas Journal, V.140, pp.17-20, June, 1934

V-012
Vuets, M.P.
Hydraulic Fracturing in the Groskneft Field (MTWL: 832, 6 pp.) Order from OTS or ETC - Trans. No 61-7380 (Trans.of Neftyano Khozyaistvo (USSR), V. 34, pp. 22-24, 1956

Hydraulic seals, mineral oils, production petroleum.

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W-013 T
Ward, J.
Chart for Leakage in Labyrinth Packing
Engineering, V.128, p. 65, July 19, 1929

A formula is given which is commonly used in Great Britain and the U.S. for calculation of leakage through a steam turbine dummy piston or labyrinth seal in which the cross-sectional area of flow is constant. The author has developed a chart for rapid evaluation.

W-014
Warring, R.H.
Felt Washer Seals
Power Transmission, V.26, No.308, pp. 698-99, 1957

W-015 B
Warring, R.H.
Metal O-Rings
Hydraulic Power Transmission, V.4, No.37, pp. 34-5, Jan., 1958

W-016
Warring, R.H.
Dynamic Applications of O-Rings in Hydraulic Services
Hydraulic Power Transmission, V.5, No.52, pp. 250-253, April, 1959

Basically simple seal effective at fulfilling requirements of dynamic operation, available in wide range of materials for meeting specified mechanical requirements and for resistance to particular hydraulic fluids; grooves for rings may be trapezoidal, V-shaped, or rectangular for static seals; simple installation, excellent sealing characteristics, and simple maintenance noted.

W-017 T
Warring, R.H.
Hydraulic Seal Friction and Performance Factors
Design News, V.14, pp. 54-57, Nov. 9, 1959

A chart for estimating seal friction is included with a discussion of seal friction and the variation of friction coefficient with pressure.
This article is concerned only with lip seals.

W-018
Warring, R.H.
Evaluation of Frictional Losses with Seals
Hydraulic Power Transmission, V.5, No. 60, pp. 772-775, Dec., 1959

Not all mechanical losses are due to simple rubbing friction; extrusion of seal under working conditions may produce severe wedging of flexible type seals and packing; chart enables determination of friction force for elastomer seals by relating seal diameter, pressure of system, and coefficients of friction for varying pressures.

W-019
Warschauv, D.M., Paul, W.
Unsupported Area High Pressure Seal
Rev.Scien.Instr., V.28, No.1, p.62, Jan., 1957

Describes modification of the unsupported area seal developed by P.W. Bridgeman
Neoprene rubber, optical plugs, Teflon, were used.

W-020
Wasbauer, A.M.
Improved Closures for Anti-Friction Bearings
Product Eng., V.4, pp. 418-9, Nov., 1933

Felt seals, metal sealing rings, labyrinths, grooves and slingers used for sealing bearing housings.

W-021
Waters, E.O., Weatstrom, D.B., Williams, F.S.G.
Design of Bolted Flanged Connections
Mechanical Engineering, V.56, pp. 736-8, Dec., 1934

The authors are commenting on the important phases of flange design with the hope that they may cast light on some of the reasons that lie behind various sections of rules and codes of the ASME, API-ASME for pressure vessels. Areas covered are gasket design, bolting design, and flange design. Also presented is a table of contact pressure ratios.

W-022
Waters, E.O., Weatstrom, D.B., and others
Bolted Flanged Connections; Formula for Stresses
ASME Trans., V.59, pp.161-169, April, 1937

This paper outlines a revised analysis based on the ring, tapered hub, and shell being considered as three elastically coupled units loaded by a bolting moment, a hydrostatic pressure, or a combination of the two. Design formulas and charts are given for the computation of stresses that are likely to be critical, and their application is illustrated by three problems taken from current commercial practice.

W-023
Watson, A.
Stuffing Boxes Dispensed With on Engines and Pumps
Instn. Mining Eng., Trans., V.25, pp.259-263, 1902-1903

A paper read before the Min. Inst.of Scotland, on stuffing boxes without glands. Also abstract of discussion.

W-024
Watson, C.L., O'Neil, J.E.
Electronic Equipment Pressurization System Study
PB 131713, Off.Tech.Serv. (302 pp.), Jan., 1958

A study and evaluation of various pressurization systems which might be employed to pressurize the sealed containers and replenish the air lost from the containers through mechanical seals.
AD 142270

W-025 B
Webster, E.A.
The Evaluation of High Temperature Hydraulic Seals
WADC Tech.Report SS-120 (96 pp., 71 fig., 39 ref.), Jan., 1955

Report of an extensive testing program carried out by the Douglas Aircraft Company under Air Force Contract with the object of developing high pressure piston seals suitable for a temperature range of -65°F to 300°F. The investigation covered some sixty different types of seals and material, including determinations of temperature limitations of current O-ring seals and back-up rings. A bibliography of thirty-nine publications relating to high-temperature seals is included.

W-001
Wadey, W.G.
Standards for Vacuum Fittings
Vacuum, V.4, No.1, pp.53-57, Jan. 1954

A report on a system of vacuum flanges sealed by O-rings which is being considered for presentation to the American Standards Association by a committee of the technical society. The Committee on Vacuum Techniques for adoption as an American Standard. Drawings and tables included.

W-002
Wagner, R.E.
These Gaskets Are Sprayed On
Product Engineering, V.28, pp.90-91, Oct.14, 1957

This new technique uses a standard metallizing method to coat cover plates with aluminum. Type 1100 aluminum alloy built up to 0.032" thickness. Re-use of joint limited to three or four times. Details of preparation, application, and use are presented. Pictures included.

W-003
Wakefield, J.E.
Metallizing of Packing Areas
Welding Journal, V.28, pp.875-876, Sept., 1949

Procedures for rebuilding worn packing areas on pump shafts, sleeves, rams, plunger, turbine shafts, and other parts.

W-004
Wakeman, W.H.
Packing Piston Rods
Am. Mach., V.21, pp.465-6, June 23, 1898

Gives points on the packing and oiling of piston rods.

W-005 T
Walker, J.E.
Shaft Sealing Means for Pumps
U.S. Patent 2,311,641, Oct. 12, 1943

Seal for a suction lift centrifugal pump used to pump fluids containing abrasive materials. The sealing members are closely spaced synthetic rubber parts which deform to allow passage of abrasives. A synthetic rubber jacket is vulcanized to a metal sleeve keyed to the shaft.

W-006
Walker, W.R.
Design Handbook for O-Rings and Similar Elastic Seals
WADC Tech.Report 59-428, Part II (103 pp.), April, 1961

Data presented herein is concerned with hydraulic and pneumatic systems utilizing static and dynamic type seals at temperatures exceeding 275°F and for static applications at cryogenic temperatures. Hydraulic systems; pneumatic systems; fuel seal systems; vacuum seals; cryogenic systems seals; aging and age control.

W-007
Walley, J.W.
Magnetic Seal for Rotating Shafts
AEI Engng., V.2, pp. 89-93, Mar./Apr., 1962

A flexible seal is formed by a membrane of iron particles in oil, the iron particles being attracted by a magnetic field between a rotating shaft and its bearing housing. Advantages are absence of wear in the gland itself and ability to allow for shaft displacement. Possible applications are electrical machinery in mines and oil refineries, gas and vacuum systems, turbines, and gear boxes.

W-008 T
Walmsley, J.G., Ward, H.A., Jr.
Mechanical Shaft Seals; Troubles and Trends
Petroleum Refiner, V.32, No.9, pp.203-206, Sept., 1953

Description of the design operation, maintenance, and cost of mechanical seals. The difference between balanced and unbalanced seals and the relation of the seal loading to seal life is considered.

W-009 T
Walti, F.D.
The Oil-Free Reciprocating Compressor
Engineering, V.177, pp. 533-535, April 23, 1954

Describes the use of labyrinths to replace piston rings in a reciprocating compressor. Leakage rates which approach those of piston rings have been obtained. The chief advantages are lack of oil contamination of the compressed substance and low friction losses. Labyrinth profiles are shown, and experimental data correlating leakage rates. Clearance gap, profile, length of seal, and initial pressure are included.

W-010
Anon.
Prerequisites for the Study of Piston Ring Seals
PB-36533, Off.Tech.Serv., 40 pp., Jan. 1941

Former improvements on gas sealing piston rings were concerned mainly with materials and processing. The construction shape in most cases is determined by the square or rectangular cross-section of the "Ramsbottomring." Previous skills combined with new methods with consideration of secondary phenomena lead to correct evaluation of piston ring seals. Photographs and diagrams are included.

W-011 T
Wannier, G.H.
A Contribution to the Hydrodynamics of Lubrication
Quarterly of Applied Mathematics, V.8, No.1, pp. 1-32, April, 1950

Comparison between the Reynolds equation and Stokes equation. The author suggests that the formulas for load capacity and friction coefficient developed in the paper have more rigor and generality than the normally used equations, but that they may be of limited usefulness due to lack of understanding of the low-pressure region of the bearing. The author theorizes the possibility of reverse flow in the divergent flow region.

W-012
Warburton, H.
White Metal Stuffing Box Rings
Mech. World, V.110, pp. 173-5, Sept.12, 1941

Packing material in stuffing boxes of steam engines, steam pumps, fuel and other pumps, etc. must, to function efficiently, be able to withstand varying temperatures and pressures to which it is subjected without becoming hard and dry with consequent scoring of rod; metallic packings for general and special purposes are described.

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W-026
Webster, E.G. and Larkin, R.G.
Choosing Rubberlike Materials for Use With Synthetic Hydraulic Fluids
SAE Jour., V.67, No.3, pp. 41-43, March, 1959

Factors in selection of basic gum or family of polymers for seals and gaskets, flexible hose liners, line clamp cushions and accumulator diaphragms in aircraft applications; methods of predicing material compatibility with particular fluids are "similarity rule" and "solubility parameter concept"; attributes of three typical O-ring materials with regard to hardness, ultimate tensile strength and compression set.

W-027
Webster, E.W.
Vacuum Tight Mechanisms
Electronic Engng., V.17, pp.53-57, July, 1944

Typical joints allowing movement include the simple cylindrical cone, Wilson's sliding seal, rubber tubing and metallic bellows. Magnetic or electromagnetic operation is best for many applications. Many practical notes are given.

W-028
Wehrse, R.
Glass-Sealing for Pressurized Cabins
Lilienthal Ges. Luftfahrtforsch, p. 71, Report 129
Spec. Lib. Assn. Trans. 3132 (24 pp.), V.3, No.8, August, 1957

W-029 B
Weimer, H., Gilbert, E.
Non-Lubricated Reciprocating Compressors. Part II-Synthetic Carbon as Sliding Contact Material and Its Industrial Application (In German)
Verein Deutscher Ingenieure Zeitschrift, V.101, pp. 596-602, May 21, 1959

In many aspects, the properties of synthetic carbon differ fundamentally from those of metals employed for sliding contact duties. Consequently, there are a number of viewpoints that must be taken into consideration when designing synthetic carbon machine elements. Successful examples quoted.

W-030 B
Weitzel, D.H., Robbins, R.F., and others
Elastomers for Static Seals at Cryogenic Temperatures
Paper D6; Proc. 6th Cryogenic Engineering Conference, pp. 219-27, August, 1960

W-031
Weitzel, D.H. and others
Low Temperature Static Seals Using Elastomers and Plastics
Review of Scientific Instruments, V.31, pp. 1350-1, Dec., 1960

Demountable high vacuum or high pressure static seals for source at cryogenic temperatures can be made from common elastomers such as natural rubber, nitrile rubber, and Viton A, as well as from high strength plastics such as Mylar and Nylon. Flanges must be designed to complement the properties of the seal material. Examples, test data, and discussion presented.

W-032
Wells, V.W.
Frequent Cause of Packing Failure
Power Plant Eng., V.39, p. 352, June, 1935

Failure dpe to the fact that the inside follower plate did not properly grip the packing with the result that when the leather became wet and soft, friction of the cylinder gradually stretched and pulled it out from under the follower plate.

W-033
Werkenthen, T.A., Swenson, A.D. and others
Sealing and Seal-Aging Properties of Rubber Gaskets
Rubber Age, V.56, pp. 389-396, Jan., 1945, pp. 513-8, Feb., 1945

Account of investigation of medium, soft, natural and synthetic rubber gaskets for various types of closures. (Bibliography)

W-034
Wertheim, F.E.
Gaskets and Packing for Hydraulic Power
Heating-Piping, V.4, pp. 202-3, March, 1932

Brief article and drawings. Advantages of hydraulic power; packing piston for hydraulic cylinder; pipe joints; designing a copper gasket; use of soft iron gasket; piping should be constrained to avoid whip.

W-035
Wertheim, F.E.
Designing Copper Gaskets for Hydraulic Piping
Heating-Piping, V.5, pp.88-9, February, 1933

Author-reader comments presented on previously published article. Derivation of the Baumann formula used in design of flanged joints is also given. Table of data - Compression Tests of Sheet Copper, Drawing.

W-036
Wertheim, F.E.
Holding Properties of Gaskets Studied
Heat, Piping & Air Cond., V.8, pp. 367-9, July, 1936
(Abstract translation of a German paper by E.Seibel and others in Forsch.Gebiete des Ingen., V.5, pp. 298-305, Nov.-Dec., 1934)

Investigation of holding properties of gaskets subjected to steam heat; various gasket materials and shapes.

W-037
Westbrock, A.J., Cornell, J.J.
Seals, Bofors 40 MM Gun, Recoil Cylinder Packing Ring
PB 31685, Off. Tech. Serv. (28 pp.), March, 1944
(Chrysler Corp.Eng.Div., Tech.Rept. G-61806.12)

Results of tests made to compare the durability of various sealing elements for the recoil cylinder packing ring of a Bofors 40 mm gun to determine which type gives the best sealing quality in the range of temp. from -40°F to 150°F. Seals of the original design and material proved most satisfactory. Illustrations, graphs and tables are included.

W-038
Wexler, A. and others
Low Temperature Gaskets
Review of Scientific Instruments, V.21, pp. 259-60, March, 1950

Gold wire, 0.020 in. dia., sealed the copper container.
Because of the general interest in the tightness of the gasket when the seal is exposed to superfluid helium, the test method was elaborated so as to decrease the lower limit to 5 x 10^{-9} micron liter/sec. Details of this specific case presented.

W-039
Whalen, J.J.
Leakage and Elastic Characteristics of Compressed Asbestos Sheet Packing
ASME Paper N58-SA-28, p.27, June 15-19, 1958

Variables investigated were bolt load, gasket width, gasket thickness and flange surface finish. Leakage data were correlated with respect to m-value; it was found that m-value is not constant and typical curves were derived from various leakage pressures and area ratios; new design equations derived to predict required total bolt area necessary for joint tightness.

W-040
Whalen, J.J.
How to Select The Right Gasket Material
Product Engineering, V.31, pp. 52-56, Oct. 3, 1960

Presents a 4-step procedure: (1) calculate total bolt force applied to joint at time of installation; (2) select a material that will seat; (3) check the hydrostatic end force, and (4) specify the flange-surface finish.
To follow this procedure, 5 tables are given of: (1) pressure-temperature value for gasket materials; (2) stress areas for flange bolts; (3) minimum seating stresses for typical gasket materials; (4) typical gasket cross-sections, and (5) safety factors for gasketed joints.

W-041
Whalen, J.J.
Select and Apply Gaskets Effectively
Chemical Engineering, V.69, No.20, pp.83-88, Oct. 1, 1962

Some points to remember when specifying gasketed joints, with an emphasis on installation bolt force and seating stress.
How to determine the suitability of gasket material, compressed asbestos or metal gasket.
Gasket application; minimum stress for sealing; calculating installation bolt force; gasketed joint analysis; check points.

W-042 B
Whalley, E.
O-Ring Seals for Pressures of 10 Kilobars
J. Sci. Instrum., V.36, No.1, pp. 47-8, January, 1959

Description of O-ring seals that have been used up to 10 kilobars successfully. Drawings included.

W-043
Wheeler, W.R., Carlson, M.A.
Ultra-High Vacuum Flanges
Transactions of the Vacuum Symposium, 1961

A study has been made of the performance characteristics of four leading designs of all metal flange seals. The aim was to determine which of the designs offered the best combination of performance, reliability, convenience of use, and practical manufacture. Data are presented on leak rate, sealing life, take out to 880°C, resistance to mechanical damage, technique of use, and corollary information. Analysis of the sealing mechanism is also presented to explain the differences in performance.

W-044 T
Whipple, R.T.P.
Herringbone Pattern Thrust Bearing
Atomic Energy Research Establishment T/M29 (8 pp.), August 24, 1949

The bearing consists of a plane circular disc or ring rotating about its axis parallel and slightly separated from a stationary disc or ring on which a set of grooves is arranged in a herringbone pattern. The moving plate drags the fluid into the grooves and develops a pressure which reacts against the axial load, thus forming a thrust bearing.

W-045 T
Whipple, R.T.P.
Theory of the Spiral Grooved Thrust Bearing with Liquid or Gas Lubricant
Atomic Energy Research Establishment T/R622, March 6, 1951

The stated object of this paper was to calculate the thrust for the spiral groove thrust bearing and to find the optimum shape of the grooves at low speed. This type of bearing uses constant-depth grooves cut into the surface of a circular plate to generate, hydrodynamically, a thrust carrying pressure distribution within the bearing.

W-046
White, C.M. and Denny, D.F.
The Sealing Mechanism of Flexible Packings
Gt.Brit., Ministry of Supply, Scientific and Technical Memorandum No.3-47, Jan., 1947

Tests made to show how pressure is distributed over the surface of flexible packings and how they deform under pressure. Modifications to reduce extrusion.

W-047
White, J.C.
Why Gaskets Fail
Nat. Engr., V.49, pp. 166-7, March, 1945

Analytical discussion of basic requirements of tight gasket and some of the reasons why gaskets fail in normal service; design details of ring gasket that remained tight for 12 years under difficult service conditions; unit pressures on fibrous and ring gaskets; why fibrous gaskets leak.

W-048
White, W.P.
Improvements In Or Relating To Sealed Joints
British Patent 896,352, May 16, 1962

A sealed flanged joint is designed for use between pipes of metals having different thermal expansion coefficients.

W-049 T

Whitefield, J.E.
Shaft Seal
U.S. Patent 2,732,232, Jan. 24, 1956

A shaft seal which is converted into a labyrinth after installation. A hollow annular ring made of soft metal (softer than the shaft) is press fitted into the housing. The shaft has a circumferential Vee-shaped ridge machined on it and fits through the seal with small clearance. The hollow space in the sealing ring is provided with a pressure fitting and after installation the shaft is pressurized, forcing the soft metal into the grooves and forming a labyrinth seal.

W-050 T

Whitley, S., Williams, L.G.
The Gas-Lubricated Spiral-Groove Thrust Bearing
United Kingdom Atomic Energy Authority TG Report 28 (RD/CA)(33 pp.), 1959

An existing hydrodynamic theory of load-carrying capacity is developed, and optimum values of the four important groove variables are obtained. Three thrust plates of outside diameters 5.55, 6.5 and 9.5 inches, respectively, are investigated experimentally, and the results are compared with theory.

W-051

Whitley, S., and Williams, L.G.
Principles of Gas-Lubricated Shaft Seals
Jour. Mechanical Engng. Science, V.4, pp.177-187, June, 1962

Four seal types for rotating shafts: hydrodynamic disc seal (based on the spiral-groove thrust plate), hydrostatic disc seal (based on a hydrostatic full-face thrust plate), hydrodynamic sleeve seal (based on a hydrodynamic full journal bearing), and hydrostatic sleeve seal (based on a hydrostatic journal bearing).
Examples of each type for use on a 2 in. shaft at 9000 rpm with zero pressure in the sealed system. Seals used to separate oil-lubricated bearings from the atmosphere can also be used for sealing a system containing gas at high pressure and temperature, such as in a gas-cooled reactor.

W-052

Wiest, E.N.
Metallic Stuffing Box Packing
Am. Mach., V.19, p. 645, July 2, 1896

A two-ring packing, illustrated and described, with composition of alloy for such packing.

W-053 T

Wigg, R.E., Battle, N.
Improvements In Or Relating To Sealing Means
Great Britain Patent 834,923, published May 11, 1960

A modified design of the screw viscosity pump arranged to provide a shaft seal against leakage of pressurized gas in conjunction with the self-aligning visco seal. Mechanical seals are provided and arranged to become automatically effective under low speeds and stationary conditions. Three designs are shown.

W-054

Wigotsky, V.W.
Silicone Rubber for Seals, O-Rings and Gaskets
Design News, V.16, pp. 8-11, April 24, 1961

Good retention of elastomeric properties and flexibility when exposed to temperatures of 500°F constantly and up to 600°F intermittently; flexibility without cracking when exposed to temperatures as low as -130°F. Good immunity to water and humidity, and little effect on physical and electrical properties by a variety of chemicals, oils and fluids.

W-055 T

Wilcock, D.F.
Turbulence in High-Speed Journal Bearings
Trans. Amer. Soc. Mech. Engrs., V.72, pp.825-834, August, 1950

Measurements of operating characteristics of journal bearings up to high surface speeds have revealed abnormalities beyond a certain critical value. A rapid increase in bearing torque, power loss, and oil film temperature occurs as speed increases beyond the critical value, while oil flow decreases below normal. These phenomena are attributed to instability or turbulence in bearing oil film.

W-056

Wilkinson, H.N.
Seals for Roll Neck and Roller Table Bearings
Engineer, V.204, pp.409-415, Sept. 20, 1957

Problems discussed are pertinent to steel mill installations. This report covers special problems involved and surveys the various kinds of seals available, their suitability and main requirements for their efficient operation.
The lip seal is dealt with in detail with temperatures to 150°F and pressures of 30 lb. per sq. inch being measured.

W-057 T

Wilkinson, S.C.W.
Development in the Use of Radial Face Mechanical Seals for Gas Sealing Applications
Int. Conf. on Fluid Sealing, Paper C3 (7 pp.), April 17-19, 1961
British Hydromechanics Research Assn., Harlow, Essex, England

Outlines four years of progress, 1956-1960, in gas sealing techniques by Crane Packing Ltd. Early experimental investigation led to the design of the main coolant gas circulator drive shaft seal for a nuclear power station. Problem and its solution of coolants covered.
The limiting conditions for gas seals have been made as high as those for liquid seals.

W-058

Wilkinson, S.C.W.
Mechanical Seal Design
Engineering Materials and Design, V. 5, pp. 572-576, 664-667, Aug.-Sept., 1962

Radial face-type shaft seals. The following design features are discussed: surface finish, mechanical seal distortion, hydraulic face distortion, heat dissipation paths, adequate cooling circulation, wetting properties, fluid pressure relative to face loading, seal balance, and solids in suspension.

W-059 T

Williams, A.E.
Machined Carbon Products
Mechanical World, V.130, pp.107-09, August 3, 1951

This article describes some general features of two uses of carbon products: mechanical seals, and vanes for pumps and compressors.

W-060

Williams, B. G
Mechanical Seals. I. A Survey of Present Day Practice.
Chemical & Process Engineering, (I) V.36, pp.73-78, March, 1955; (II) V.36, pp.124-126, April, 1955

I - Types and application. Graphs and diagrams.
II- Operation, maintenance, and applications. Graphs and diagrams.

W-061

Williams, H.T.
Grooveless O-Ring Vacuum Seal for Bell Jars and Other Demountable Components
Rev. Sci. Instr., V.26, p. 1207, 1955

A separate retaining plate for supporring an O-ring at the bell jar seal is described which did not enter into the vacuum seal but served as a backing to keep the O-ring from being pushed into the vacuum system while the proper O-ring compression is maintained. Use of this modification did away with machined retaining grooves.

W-062

Willis, W.W.
An All-Metal Sealing Joint
Missile Design and Development, V.4, pp. 18-19, August, 1958

Describes Marman Conoseal joint and gives some test data indicative of its performance.

W-063

Wilson, R.R.
Vacuum Tight Sliding Seal
Rev. Scientific Instruments, V.12, pp. 91-93, Feb., 1941

The operation and construction of a vacuum-tight sliding seal by means of which unlimited translational and rotational motion in vacuum can be obtained is described. The seal is made by an appropriately distorted rubber gasket and a table has been prepared which gives the dimensions of the gaskets to be used for various sizes of sliding rods. Drawings included.

W-064

Wilson, W.H.
Blind Gasket
Heating & Piping, V.1, p. 85, May, 1929

The blind gasket, its description and application. It is common practice to cut it out of steel plate with an oxy-acetylene torch. The part projecting from the disc, or handle, must be narrow enough to pass between the bolts, and readily identifies the presence of blind gasket

W-065

Windenberg, D.F.
Master Charts for the Design of Vessels Under External Pressures
PB L 85991, Off.Tech.Serv., May, 1947 (Reprint from Trans.of ASME, pp.345-351, May, 1947)

This paper presents the theoretical equations underlying non-dimensional charts suitable for the design of circular cylindrical steel vessels under external pressure. The methods used in constructing the chart and their advantages and limitations are discussed. It is shown also how the chart can be used for the design of pressure vessels constructed of non-ferrous and other materials which have non-linear compressive stress-strain curves.

W-066

Wingrove, T.R.
Packing a Compressor Piston
Ice & Refrig., V.27, pp. 4-5, July, 1904

Discusses the wrong and right way of packing a rod.

W-067

Winkhaus, A.
Steam Loss in Labyrinth Packings (In German)
Zeit. des Ver. Deut. Ing., V.66, pp.804-807, Aug. 26, 1922

Discussions based on tests.

W-068

Wirta, R.W.
Gold Gaskets for Process Piping
G.E.Co., Hanford Atomic Products Operation, Richland, Wash. Contract W-31-109-eng-52, HW-48480 (5 pp.), Feb. 14, 1957

Gold exhibits excellent physical gasketing properties on a 1-inch flange with pressures less than 90 psi. Not suitable for use with stainless steel.

W-069

Wisander, D.W. and others
Wear and Friction of Filled Polytetrafluoroethylene Compositions in Liquid Nitrogen
ASLE Trans., V.2, No.1, pp.58-66, April, 1959

Bearings and seals of missile power plants have to work under extreme conditions and it is necessary to investigate materials at very low temperatures for this purpose. Described are results of tests on PTFE materials of molded form and extruded form with different fillers including carbon, graphite, glass, metal and ceramic in concentrations up to 25%.

W-070

Wisander, D.W., Hady, W.F., Johnson, R.L.
Friction Studies of Various Materials in Liquid Nitrogen
NACA TN 4211, 1958

W-071

Wisander, D.W., and Johnson, R.L.
Wear and Friction of Impregnated Carbon Seal Materials in Liquid Nitrogen and Hydrogen
N-85890, 1960 Cryogenic Eng.Conf., Boulder, Colo.
Advances in Cryogenic Engng., V.6, pp.210-218, 1960

Experimental wear and friction studies were conducted with a series of impregnated carbon materials sliding against metal surfaces in liquid nitrogen ($-320^{o}F$) and in liquid hydrogen ($-423^{o}F$) at sliding velocities to 12, 000 f/min. These mechanical carbons have potential use in dynamic seals for these fluids.
Data are presented for a basic carbon grade, commercial impregnated carbons, various experimental impregnants of basic mechanical carbons, and commercial plastic matrix bodies.

W-072 B
Wizeman, K.C.
Metallic Packing: Best for Gases
Power, V.102, No.8, pp.120-2, August, 1958

A description of metallic packings in reciprocating compressors, installation, lubrication, packing material, the radially slit ring, split case, metallic scraper rings.

W-073
Wolf, J.E. and Connelly, R.E.
Development of Seals for Rocket Engine Turbopumps
ASLE Trans., V.2, No.1, pp.25-31, 1959

Principle of liquid rocket engine with turbine driven pumps and sealing problems involved; operating conditions of typical turbopump seals and allowable static leakage rates; development of oxidizer, fuel, impeller, hot gas, and oil seals; seal installation, testing and development.

W-074 T
Wolfson, M.R.
Shoe Design and Material Studies for High Speed Sliding Friction Applications at Snort
Navord, Report 5626, ASTIA Document No.AD-206332, Aug. 27, 1958

Investigation of friction, wear, lubrication, material selection, and component design for sledshoes used at the Supersonic Naval Ordnance Research Track. A mechanism of wear of unlubricated rubbing surfaces postulates the formation of a molten film at the contact area. Some limited data confirms the validity of the theory.

W-075
Wood, D.F.
Rubber Boot Gas Seal Properties, Tests
Knolls Atomic Power Lab., Schenectady, N.Y., KAPL-M-EDL-19 Contract W-31-109-eng-52, 68 pp., June 1, 1953

A series of tests was conducted for the purpose of evaluating the properties of the rubber boot seal used on the control drive shaft of a submarine.

W-076
Wood, D.F.
Rotating Plug Rotating Seal Test
Knolls Atomic Power Lab., Schenectady, N.Y., KAPL-M-EDL-120 Contract W-31-109-eng-52, (35 pp.), Aug. 23, 1956

An investigation was conducted for the purpose of developing a seal and determining the proper seal lubricant to control the gas leakage from the S1G reactor during operation of the rotating plunger. The flow of diffusion gas, i.e., seal leakage, was in the order of 0.001 standard cubic feet per hour of helium at 10 psig. Plastilube No.1 proved the most satisfactory seal lubricant.

W-077
Wood, D.F.
O-Ring Tests; S1G/S2G
Knolls Atomic Power Lab., Schenectady, N.Y., KAPL-M-EDL-127 Contract W-31-109-eng-52, (24 pp.), June 28, 1957

An investigation was conducted to determine the operating characteristics and limits and the optimum use conditions of O-ring seal on the S1G/S2G control plug shaft. Temperature range of 70°F to 150°F with a pressure differential of 40 psig.

W-078
Wood, F.W., Jr
5 Important Gasket Materials
Prod.Engng., V.30, pp.93-95, Dec. 7, 1959

Quick-reference facts to aid selection among paste, felt, cork, rubber, and metallic seals.

W-079 T
Wood, H.J.
Labyrinth Seal
U.S.Patent 2,781,210, February 12, 1957

A method of forming a labyrinth seal in a substance capable of plastic flow. A plate on the housing has a bore lined with a substance such as lead. The inwide diameter of the lining is slightly smaller than the outside diameter of a circumferentially grooved collar which is secured to the shaft. When the seal plate is forced over the shaft collar, and the shaft is subsequently rotated, frictional heating caused a plastic flow of lining into the collar grooves, and forms a labyrinth seal.

W-080
Wood, T.D.S.
Packings in PTFE Tolerate Rough Shafts
Engineering, V.188, p.387, Oct. 23, 1959

Chevron rings made of polytetrafluoroethylene for packing the glands of high-pressure valves. Advantages of these rings are low friction on valve spindles, chemical inertness, and stability to 300°C. Tests were made to determine the influence of shaft surface finish on the wear rate of the rings, and to compare the performance of machined and molded rings. It was found that shaft roughness has no effect on wear rate, except that initial friction and leakage were high with very rough shafts. Also molded rings wore less than machined rings.

W-081
Wood, T.H.
Mechanical Shaft Seals in Chemical Industry
Trans.Instr.Chem.Engrs.(London), V.32, pp.73-80, 1954

The design, operation, and materials of construction of mechanical seals for both balanced and unbalanced types are presented. Working pressures vary from 2×10^{-4} mm of Hg to 600 psi, and temperatures from -90°F to 600°F at speeds up to a maximum of 6000 fpm.

W-082 B
Woodhouse, H.
Centrifugal Pump Packings and Seals, Part I, Packings and Glands
Petrol.Refin., V.36, No.1, pp.163-6, Jan., 1957

The first article is devoted to construction features and application of various types of stuffing boxes and glands. The author describes how seals work and shows why different types are required in different cases.

W-083 B
Woodhouse, H.
Centrifugal Pump Packings and Seals, Part II, Packings
Petrol.Ref., V.36, No.2, pp.173-7, Feb., 1957

This article indicates the various types of packing that are used in stuffing boxes and contains a comprehensive guide for the selection of the correct packings for the fluid being pumped.

W-084 B

Woodhouse, H.
Centrifugal Pump Packings and Seals, Part III, Mechanical Seals
Petrol.Refin., V.4, pp.207-11, April, 1957

The third article discusses mechanical seals, where they should be used, what types are available, and how they should be handled.

W-085 B

Woodhouse, H.
Centrifugal Pump Packings and Seals, Part IV, Mechanical Seal Maintenance
Petrol. Refin., V.5, pp.243-6, May, 1957

Starting with a warning that mechanical seals must be handled and fitted with great care, the author demonstrates how to trace cause of seal troubles, discusses where leakage is likely to occur, and then gives appropriate remedies for each trouble.

W-086 B

Woodhouse, H.
Centrifugal Pump Packings and Seals, Part V, Packing Maintenance
Petrol.Refin., V.6, pp.193-7, June, 1957

In the last article in this series, the author attributes the majority of stuffing box packing troubles to faulty maintenance. The correct procedure for repacking and maintaining the gland is described, and a sensible trouble-shooting chart is given.

W-087

Woodhouse, H.
Know Facts About Pump Packings and Seals
Pipe Line Industry, V.6, No.6, pp. 55-58, June, 1957; V.7, No.1, pp. 56-59, July; No. 2, pp. 55-59, August; No. 3, pp.44-47, Sept.; No. 4, pp. 58-62, Oct., 1957

Construction features, installation, and maintenance of packing boxes and glands, packings, mechanical seals, mechanical seal maintenance and packing maintenance for centrifugal pumps used on large pipe line systems.

W-088 T

Woodrow, J.
Viscosity Plates- Flow and Loading
Atomic Energy Research Establishment, E/M (6 pp.) Dec. 22, 1949

The radially inward flow between annular viscosity plates is investigated by methods of lubrication theory. The flow rates and pressure distribution are obtained for isothermal flow of gas and for incompressible fluid. The resultant forces on the plate due to the radial flow are worked out for the same two cases. (Author)

W-089 T

Wordsworth, D.V.
The Viscosity Plate Thrust Bearing
Atomic Energy Research Establishment, E/R 2217, October, 1952

Part I reconsidered the theory presented by Whipple, indicating that the load carrying capacity of the viscosity plate thrust bearing increased approximately linearly with speed. Considering aerodynamic effects, substantially agree with Whipple. Part II outlines the study of other possible causes of experimentally observed deviations.

W-090

Wright, E.F.
Reciprocating Pump; Rod, Piston and Plunger Packing
Power, V.91, pp. 346-8, May, 1947

Selected questions and answers that give practical understanding of construction, operation, characteristics, troubles and remedies (17 total). Photographs and drawings included.

W-091 T

Wright, R.
Mechanical Seals Eliminate Leakage and Simplify Handling of Liquids
Ind. and Engng. Chem., V.42, Supplement pp. 97A-98A, Aug., 1950

A brief descriptive discussion of mechanical face seals and their relation to design is presented, and some unique designs are shown.

W-092

Wroble, W.R.
Designing Hydraulic Cylinders for High Pressures
Mach., V.57, pp. 149-152, Sept., 1950

Outlines a method for applying simple formulas and new sealing principles to high-pressure cylinder designs.

Y-001
Yarwood, J.
Isolation Valves for Vacuum Systems
Vacuum, V.3, pp.398-410, October, 1953

The chief types of vacuum valves are classified and reviewed. Requirements of vacuum valve are reviewed. Development of new and special service valves described. Valves with rubber seals, valves with silver chloride seals, valves with metal-to-metal seals, valves for ultra-high vacuum. Data, drawings, and photos. References.

Y-002
Yarwood, J.
Symposium on Some Aspects of Vacuum Science and Technology- London, January, 1962
Brit. J. Appl. Physics, V.13, No.7, pp. 301-5, July, 1962

1) Introduction; 2) Cryogenic pumping; 3) Molecular sieve pumping; 4) Ultra high vacuum; 5) Seals and gaskets: wire gasket, the welded seal, Farkas seal with coolant channel, knife-edge gaskets; 6) Mass spectrometry; 7) Leak detector.
Gold wire, stainless steel, aluminum wire, Viton, neoprene, diamond-shaped copper, etc.
Data and drawings.

Y-003
Young, E.L.
Air-drying System for EBWR Turbine Seals
Nucleonics, V.15, No.4, pp. 105-106, April, 1957

How drying and moisture recovery system applied to Experimental Boiling Water Reactor steam plant at Argonne National Laboratory will prevent loss of valuable moderator and escape of radioactivity to atmosphere; system is automatic and remote controlled; schematic diagram of type of seal developed for 5000-kw. turbine, and of drying and moisture recovery system.

Y-004
Young, J.R.
Vacuum Limits of Rubber O-Ring Joints
Rev.Sci. Instrum., V.29, No.9, pp. 795-6 (Notes Section), Sept., 1958

In this note, the author indicates that the limiting pressure in many systems having neoprene rubber O-rings is due to the liberation of butane from the rubber.
(Rubber O-ring: 2×10^{-6} to 1×10^{-6} mm Hg for 3 days)
(Teflon O-ring: 5×10^{-8} mm Hg for 24 hours)

Y-005
Young, J.R.
Cleaning Techniques for Rubber O-Rings Used In Vacuum Systems
Rev.Sci. Instrum., V.30, No.4, p. 291 (Notes Section), April, 1959

Rubber O-rings which are properly cleaned or, if carefully handled not cleaned at all, do not limit the vacuua obtainable under many conditions.

Z-001

Zabriskie, W. and Sternlicht, B.
Labyrinth-Seal Leakage Analysis
Jour. Basic Engineering, ASME Trans., V. 81, pp. 332-340, Sept., 1959

Study of fluid-flow aspect of gas leakage through straight-through labyrinth seals of type commonly used in gas and steam turbines. Includes staggered and unstaggered seals of the axial type. Leakage calculation methods within 20% accuracy are presented.

Z-002

Zotov, V.A.
Research on Helical Groove Seals
Russian Engineering Journal (Translation of Vestnick Mashin (USSR), V.10, pp. 3-7, October, 1959)

After examining the three components of the flow past a helical groove or screw seal, the author shows that the ratio of the pressure rise to the product of the fluid viscosity and seal speed is equal to a function of six geometrical quantities.

Some experimental results of a one-inch diameter shaft with speeds up to 10, 000 rpm and pressures up to 710 lbs/sq.in. are presented.

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SUBJECT INDEX

I. KINDS OF SEALS

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In Compressors

A-198	C-075	G-034	0-007	P-042	S-027	S-036	S-050
T-048	W-059						

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In Launch Vehicle Sealing

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In Nuclear Plant Sealing

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In Petroleum Industry

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T-043	T-048	W-059	W-084	W-085	W-087		

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Static

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M-111	S-036	S-123	W-053				

Freeze Seal - Dynamic seal of a bushing type which also serves as a static seal by solidification of the fluid in the clearance in the absence of friction due to motion

A-155	A-156	B-003	B-004	C-037	C-079	C-080	C-081
H-046	S-006	S-127					

KINDS OF SEALS, CONT'D

Gaskets - Piece of material which is clamped between static faces

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E-026	E-028	F-002	F-006	F-035	F-036	F-037	G-018
G-025	H-005	H-025	H-037	H-044	H-057	H-068	H-072
J-004	H-027	K-018	K-033	K-048	L-001	L-003	L-014
L-015	L-021	M-068	M-075	M-082	M-088	M-097	M-098
M-099	M-112	N-004	N-019	0-001	0-008	P-032	R-009
R-010	R-011	R-017	R-028	R-039	R-042	S-007	S-015
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In Pressure Range 0 to 100 P.S.I.

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W-068							

In Pressure Range 0 to 5000 P.S.I.

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KINDS OF SEALS, CONT'D

In Pressure Range 0 to 10,000 P.S.I.

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In Temperature Range -300 to 0°F

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In Temperature Range 0 to 1000°F

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In Vacuum Sealing

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G-035	H-036	H-060	H-064	H-074	H-081	K-031	K-051
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V-001	Y-002						

In Valve Sealing

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Hermetic Seal - A permanent seal by fusion or adhesion primarily for moisture and air-tightness

B-111	K-053	L-011

Labyrinth Seal - A device employing a tortuous leakage path, usually by fins on either the stationary or rotating member

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C-075	C-076	D-020	D-055	D-069	E-007	E-032	F-001
F-034	F-045	G-016	G-017	G-043	H-033	H-059	H-067
J-013	K-008	K-009	K-011	K-036	K-044	L-009	L-047
M-018	M-019	M-046	M-093	M-102	P-013	P-021	P-044
P-056	R-044	R-063	S-012	S-024	S-038	S-088	S-093
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V-005	V-006	W-009	W-013	W-020	W-049	W-067	W-079
Z-001							

Lip or Radial Seal - Seal producing positive line contact circumferentially between the seal's inside diameter and a shaft or a rod

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G-022	G-032	G-041	H-050	H-055	H-075	H-084	I-001
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M-048	M-106	P-017	P-037	R-004	R-034	R-062	S-057
S-058	S-070	S-093	S-103	S-112	S-140	S-141	S-142
T-035	W-017	W-056					

Magnetic Seal - A seal produced by applying a magnetic field to concentrate magnetic particles suspended in the fluid

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Packing or Stuffing Box - Deformable material compressed into a cavity surrounding a rod or a shaft

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J-002	K-034	K-050	L-050	L-021	M-010	M-067	M-068
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B-074	B-109	B-127	B-129	C-002	C-026	C-031	C-032
C-066	D-023	D-025	D-028	D-030	D-031	D-039	D-040
D-047	D-050	D-051	D-052	D-063	E-005	E-019	E-025
E-026	F-002	F-019	F-022	F-029	G-022	G-037	G-039
H-008	H-014	H-016	H-039	H-040	H-042	H-051	H-052
H-063	H-068	H-070	I-013	J-012	H-018	J-021	K-006
K-032	K-033	K-036	K-037	L-020	L-021	L-034	L-040
M-001	M-006	M-018	M-024	M-028	M-031	M-033	M-038
M-045	M-068	M-089	M-094	M-102	M-105	N-001	N-008
N-009	N-018	O-002	O-009	P-018	P-036	R-001	R-031
R-036	R-037	S-009	S-010	S-032	S-037	S-042	S-065
S-069	S-088	S-095	S-129	T-019	T-020	T-040	T-051
T-052	T-053	T-056	W-004	W-018	W-032	W-039	W-046
W-052	W-067						

In Aircraft Sealing

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M-026	M-059	M-072	M-073	S-066	S-106	T-038	

In Automobile Sealing

A-179	A-222	C-006	G-032	R-043

In Bearing Sealing

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In Chemical Industry

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In Hose and Pipe Connections

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KINDS OF SEALS, CONT'D

In Temperature Range 0 to 2000°F

A-097

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C-024	C-025	C-034	C-060	C-061	C-078	D-004	D-021
D-049	D-058	D-059	D-060	E-015	F-018	F-025	F-028
G-032	G-036	H-023	H-024	H-038	H-056	H-083	J-010
J-032	K-022	L-032	M-020	M-025	M-026	M-027	M-034
M-051	M-059	M-072	M-096	N-021	P-029	P-038	R-007
R-017	R-020	S-028	S-066	S-067	S-070	S-071	S-089
S-090	S-106	S-117	S-118	S-135	T-002	T-038	T-060
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In Internal Combustion Engines

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A-024 A-124 A-127 J-032 M-109 P-017

In Liquid Metal Sealing

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In Munitions Sealing

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In Naval Ships

A-070 H-002 M-061 S-014 T-018

In Nuclear Plant

C-028 J-019

In Petroleum Industry

A-047	A-108	A-203	B-048	D-027	F-005	K-034	M-029
P-030	P-037	P-038	P-049	S-061	S-114	T-016	W-012
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A-032	A-152	A-176	B-042	C-013	C-034	D-004	F-025
H-038	H-083	M-025	N-027	P-030	R-007	R-017	T-002
T-060							

In Pressure Range 0 to 100 P.S.I.

C-042 C-060 K-003 L-046 M-032 M-067

In Pressure Range 0 to 5000 P.S.I.

A-058	A-126	A-128	B-105	H-023	H-024	I-012	M-093
S-066							

KINDS OF SEALS, CONT'D

In Pressure Range 0 to 10,000 P.S.I.

A-171	B-061	B-089	B-099	B-103	G-012	J-023	L-007
M-030	S-019	S-068	S-111				

In Pumps

A-026	A-032	A-042	A-076	A-087	A-089	A-094	A-108
A-122	A-140	A-217	B-061	B-075	B-133	B-134	C-001
C-003	C-028	C-042	C-048	C-065	D-011	D-043	D-045
E-015	F-003	G-001	G-014	H-029	H-065	H-066	I-002
J-001	J-023	K-003	K-004	K-005	K-026	L-037	L-041
L-042	L-046	M-020	M-076	M-109	N-021	N-023	P-041
P-052	P-053	P-057	R-065	S-031	S-043	S-061	S-114
T-016	T-024	T-025	T-038	T-048	W-003	W-012	W-023
W-082	W-083	W-084	W-085	W-086	W-087	W-090	

In Railway Vehicles

A-017	A-020	A-025	A-027	A-029	A-032	A-037	A-046
B-131	C-022	C-052	K-023	P-058	R-038		

In Steam Engines

A-026	A-034	D-048	H-002	H-009	J-022	M-066	U-003
W-012							

In Temperature Range -70 to 300°F

A-135	E-034	M-032	S-066	W-037

In Temperature Range 0 to 1000°F

A-075	E-001	H-083	K-046	M-030	M-093	S-019

In Gas and Steam Turbines

A-030	A-036	A-044	A-114	B-007	B-126	C-028	D-002
F-001	G-043	M-002	M-093	N-027	P-013	P-026	P-044
P-045	R-027	R-049	S-024	T-021	W-003	W-013	

In Vacuum Sealing

A-058	R-003	T-021

In Valve Sealing

A-017	A-026	A-027	A-028	A-067	A-074	A-090	A-122
A-125	A-232	B-039	B-071	C-003	C-028	C-052	C-060
C-078	D-011	F-007	H-002	J-001	M-093	P-058	R-043
W-080							

Ring Seal - A positive contact seal whose primary component is an independent ring-proportioned element

Felt, Quad, Delta, X, or other cross sections of ring seals

General

G-003

Dynamic

D-027	G-022	T-054	V-003	W-010	W-016	W-027

KINDS OF SEALS, CONT'D

Static

E-003 E-024 F-039 H-041 W-016 W-062

"O" Ring - A ring seal with a circular cross section

A-005 A-015 A-116 A-139 A-145 A-148 A-180 A-182
A-187 A-197 A-201 A-214 A-218 A-222 A-225 C-012
C-019 C-035 C-039 C-040 C-041 C-043 D-029 D-042
D-063 E-003 E-004 E-012 E-013 E-034 E-035 G-005
G-008 G-015 G-022 H-011 H-030 H-057 H-083 J-002
J-016 J-027 J-029 L-029 M-028 M-037 M-049 M-052
M-055 M-056 M-075 M-100 M-108 N-026 O-001 P-010
P-047 R-001 R-053 S-015 S-034 S-035 T-020 T-029
T-030 T-031 T-044 T-045 T-046 V-003 W-006 W-025
W-054

In Aircraft Sealing

A-151 A-187 A-190 B-064 C-025 C-039 D-021 F-048
G-003 H-024 M-059 M-072 M-073 P-009 P-047 R-018
R-053 S-125 S-126

In Cryogenic Fluids

A-216 E-003 E-014 H-030 H-052 T-046 W-006

In Hydraulic Equipment

A-091 A-143 A-153 A-165 A-169 A-176 A-190 A-216
B-008 B-064 B-079 B-105 B-118 C-005 C-011 C-017
C-024 C-025 C-039 C-045 C-060 D-021 D-035 D-062
E-014 F-018 F-038 G-003 H-004 H-023 H-024 H-038
H-083 J-015 K-012 K-025 M-034 M-050 M-051 M-053
M-057 M-059 M-072 P-008 P-009 P-020 P-035 P-047
R-018 S-070 S-118 S-124 S-125 S-126 S-135 U-004
V-003 W-006 W-015 W-016 W-025

In Launch Vehicles

A-236 E-003 E-014 J-025 R-018 V-008

In Nuclear Plants

H-004 K-010 P-001 W-077

In Petroleum Industry

D-027 D-035 F-048 J-028 P-030 S-099 T-049

In Pipe Connections

A-216 B-064 C-005 C-068 D-010 D-061 D-072 E-003
G-005 G-010 H-024 H-036 H-038 H-058 M-017 P-040
S-030 W-001

In Pneumatic Equipment

A-160 A-176 B-064 C-036 D-072 F-038 H-038 H-083
P-030 W-006

In Pressure Range 0 to 100 P.S.I.

A-015 B-090 C-023 C-042 C-060 P-001 T-049

In Pressure Range 0 to 5000 P.S.I.

A-160	B-035	B-105	D-010	D-062	F-012	H-023	H-024
I-012	U-004						

In Pressure Range 0 to 10,000 P.S.I.

A-130	B-001	D-003	E-035	F-010	F-039	J-017	L-007
P-008	P-015	T-039	W-042				

In Pumps

A-163	C-042	D-003	M-004	S-030

In Space Ship Sealing

A-190	R-054

In Vacuum Sealing

A-013	B-015	D-061	G-010	G-013	H-030	H-036	H-058
H-064	K-002	K-051	K-052	L-043	M-017	M-090	M-108
P-040	R-032	R-041	S-041	S-045	S-072	V-002	W-001
W-006	W-061	Y-004	Y-005				

In Valve Sealing

A-163	B-035	C-060	K-051	M-004	M-017	M-050	S-030
S-045	S-137	V-002					

Piston Ring - A one piece ring seal with a discontinuous circumference

General

B-047

Dynamic

A-017	A-021	A-051	A-098	A-148	A-230	A-240	B-073
B-086	B-099	C-034	D-003	D-038	D-048	D-063	F-017
E-026	F-027	F-050	G-023	H-002	H-012	H-082	J-002
K-017	M-051	P-015	P-017	P-039	P-056	P-058	S-017
S-037	S-040	S-052	S-073	S-118	T-001	T-009	T-038
T-039	W-009	W-010	W-025				

Static

B-099	J-004

Segmental Rings - A ring seal composed of several butting or interlocking segments

A-035	A-114	A-201	A-226	B-020	B-097	B-120	B-121
C-046	C-075	D-027	D-058	J-021	K-027	P-032	R-018
R-027	S-038	S-040	T-011				

"U" Ring - A ring seal having a "U" shaped cross section

A-095	A-146	A-147	A-176	B-047	C-023	C-024	C-056
D-027	D-032	D-058	F-018	F-027	G-018	G-022	G-036
H-070	J-002	M-027	M-034	S-070	S-073	S-090	T-002

KINDS OF SEALS, CONT'D

"V" Ring - A ring seal having a "V" shaped cross section.

A-041	A-125	A-176	A-214	A-216	B-045	B-047	C-023
C-024	D-058	D-063	E-024	E-032	F-003	G-022	J-002
J-032	M-026	M-027	M-030	M-032	M-034	S-065	S-069
S-070	S-090	S-118	S-135	W-016	W-080		

Special Sealing Concepts (Self sealing fuel tanks, injection seals, ceramic to metal seals, etc.)

A-002	A-003	A-147	A-171	A-181	A-230	B-001	B-009
B-036	B-050	B-057	B-089	B-090	B-099	B-114	B-117
B-125	C-051	D-003	D-062	E-009	E-035	E-036	F-010
F-039	G-012	G-021	H-016	H-061	H-071	J-017	J-023
J-025	K-027	L-007	L-027	L-033	L-034	L-045	M-005
M-007	M-069	M-074	M-075	N-001	N-007	N-011	N-015
N-027	O-009	P-008	P-015	P-034	R-010	R-021	R-022
R-028	R-051	S-003	S-018	S-019	S-068	S-087	S-098
S-131	T-059	W-042	W-049	W-079			

Screw Seal - A device comprising a threaded shaft rotating in a close clearance plain bore (or plain shaft in threaded bore), sometimes called visco-seal or screw pump.

A-233	A-235	A-240	B-074	B-077	B-112	F-046	F-047
H-076	R-058	R-059	T-037	W-053	Z-002		

II. SPECIFIC INTEREST AREAS IN SEALING

Aging or Shelf Testing

A-012	A-134	A-149	A-154	C-031	E-011	H-082	K-025
M-057	N-026	S-081	T-046	W-006	W-033		

Back-up Rings - A washer type of reinforcement placed on the side of a packaging, ring seal, or similar seal opposite the sealing interface.

A-153	A-164	B-001	B-057	B-105	D-042	F-009	G-026
H-010	H-011	H-023	J-002	K-012	K-037	M-072	P-046
R-054	T-031	T-045	T-046	U-004	W-025	W-061	

Back Diffusion - in (Bushing, Screw, Labyrinth)

A-123	B-020	B-025	B-080	S-012	S-024

Balancing of Forces - The balancing of forces due to pressure on a face seal to reduce contact pressure at the sealing interface.

C-046	F-024	G-008	H-015	H-066	H-077	K-035	L-048
M-022	M-023	M-042	M-043	M-095	N-003	N-005	R-012
R-014	R-048	S-037	S-049	S-050	S-117	S-118	W-008
W-058	W-081	W-088					

Bellows - Used alone or as a component of another seal in static or limited motion application.

A-077	A-082	A-106	A-107	A-109	A-137	B-059	B-069
C-020	E-028	H-013	H-073	K-002	L-021	M-013	M-036
M-103	R-018	R-062	S-006	S-033	S-116	S-118	T-003
U-002	W-027						

Cavitation

B-095	B-100	D-013	N-010	V-010

Compatibility

Material - Fluid: The ability of a material to exist in intimate contact with a fluid without detrimental chemical, bacterial, radiation, or other effects.

A-009	A-040	A-049	A-097	A-103	A-126	A-127	A-158
A-192	A-206	A-215	B-031	B-052	B-067	B-071	C-001
C-027	C-029	C-041	D-053	D-068	E-015	E-034	G-022
H-018	H-020	H-069	H-075	H-082	J-027	K-033	K-035
K-047	L-014	L-039	M-024	M-041	M-082	M-088	M-101
M-109	M-113	O-004	P-012	P-037	P-045	P-053	P-056
R-017	S-002	S-013	S-021	S-052	S-081	S-107	S-108
S-141	S-142	T-046	W-016	W-026	W-054	W-080	

Material-Fluid-Material: the ability of relative motion to exist at the sealing interface in the presence of a seal material, fluid, and mating material.

A-098	A-150	A-170	A-184	A-185	B-013	B-033	B-093
B-094	C-011	C-077	D-004	F-048	G-002	G-004	J-015
K-025	K-046	L-017	M-106	P-038	R-033	S-025	S-043
S-044	S-071	S-092	S-112				

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Chemical Properties

A-044	A-098	A-210	G-022	R-017	L-036	M-113	O-009
P-031	R-017	S-021	S-052	S-108	S-134	S-142	W-043
W-080							

Endurance Testing

A-006	A-007	A-047	A-149	B-006	B-097	B-115	C-009
C-033	C-038	C-065	D-017	D-034	G-019	G-036	H-029
I-013	J-009	J-027	K-033	L-007	L-022	L-032	M-023
M-042	M-051	M-077	N-014	O-006	P-037	S-095	S-114
T-031	T-049	T-060	V-002	W-008	W-037	W-043	

Faces - Effect of face surface contours or other face characteristics on the sealing capabilities.

A-174	A-231	B-101	C-054	F-022	G-011	G-020	H-015
L-022	L-033	M-091	N-003	N-024	S-004	S-039	T-057
W-058							

Flange Design

A-013	A-069	A-101	A-141	A-177	A-241	B-010	B-062
B-070	D-072	E-009	F-013	F-033	F-035	G-010	G-029
H-005	H-054	K-020	K-021	K-040	K-047	L-003	L-004
L-044	M-010	M-011	M-060	N-019	R-026	R-028	R-039
R-046	R-064	S-013	S-023	S-035	S-054	S-077	S-110
S-130	S-080	S-099	T-008	T-055	W-021	W-022	W-031
W-035	W-039	W-043					

Flange Serrations

A-101	B-010	C-066	F-033	K-041	M-010	S-110

Floating Types - sealing without directly fastening the seal to any other component. (excluding ring seals)

A-199	B-058	B-080	B-081	B-084	B-103	C-028	E-005
G-011	G-044	H-067	M-051	M-075	M-093	R-007	S-048
S-131	T-042						

Friction

General Discussion

A-058	A-072	A-091	A-098	A-125	A-139	A-146	A-149
A-156	A-208	B-054	B-118	B-124	C-005	C-017	C-023
C-025	C-041	C-080	D-018	D-022	D-026	D-032	D-035
D-036	F-031	G-008	G-022	G-023	G-025	G-041	H-055
H-057	H-062	J-003	M-037	M-059	M-064	M-101	R-023
S-053	S-075	S-141	S-142	T-002	T-013	T-032	T-038
V-010	W-009	W-011	W-017	W-020	W-070	W-079	W-080

In Face Seals

B-129	G-008	G-041	H-055	I-010	K-035	L-036	M-042
M-043	N-005						

In Lip Seals

B-129	W-009	W-020	W-079

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Friction, Cont'd

In Packings

A-046	A-058	A-060	A-061	A-072	A-091	A-125	A-237
B-041	B-129	C-025	D-023	D-053	G-022	G-041	L-032
M-059	T-002	T-025	T-038	T-040	T-052	T-056	W-018
W-032	W-080						

Friction, Torque or Power Loss Due to Friction

A-126	A-209	B-006	B-128	C-081	D-040	H-046	H-050
S-132	S-139	T-013	W-055				

Gas Sealing Applications

General

A-007	A-010	A-011	A-109	A-117	A-159	A-166	A-193
A-194	A-198	A-199	A-216	B-012	B-014	B-020	B-021
B-022	B-024	B-053	B-068	B-080	B-081	B-084	B-125
C-020	C-037	C-038	C-074	C-075	D-008	D-020	E-008
E-030	F-003	F-004	F-017	F-044	F-045	F-046	F-049
G-040	G-042	H-017	H-033	H-045	H-047	H-071	H-076
J-013	J-020	K-008	K-009	K-016	K-027	L-008	L-033
M-008	M-070	M-087	M-110	N-016	O-006	P-005	P-022
P-025	P-028	P-030	P-055	R-029	R-030	R-052	S-003
S-012	S-017	S-096	S-104	S-120	T-007	T-055	U-002
V-006	V-010	W-007	W-010	W-045	W-050	W-051	W-053
W-073	W-075	W-076	W-088	Z-001			

In Gaskets

A-049	A-079	A-172	E-010	G-035	M-082	M-107	N-016
T-017							

In "O" Rings

A-130	A-216	C-011	G-005	P-001	P-030	P-035	S-041

In Packings

A-097	A-179	A-198	A-217	B-061	D-045	D-046	F-003
J-019	K-046	M-020	M-031	M-104	N-016	P-030	R-031
S-011	S-042	S-111	W-072				

In Face Seals

A-198	A-217	A-231	B-013	B-059	C-038	C-054	C-073
C-075	D-001	L-033	M-014	M-062	O-005	P-073	S-011
S-115	S-116	W-053	W-057				

Heat Transfer - The ability of a seal to conduct heat and/or withstand thermal cycling.

A-103	A-149	B-075	C-076	D-006	D-018	D-039	D-053
E-001	G-031	H-077	K-007	K-015	L-028	M-043	M-082
M-084	M-096	S-086	S-052	S-079	T-033	W-055	W-058
W-079							

Hydrostatic Type

A-069	A-104	A-224	G-008	L-003	L-026	W-022	W-051

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Installation

A-009	A-021	A-118	A-176	B-042	B-107	C-011	C-041
C-050	C-065	D-011	D-048	D-060	E-017	E-020	E-021
F-018	F-023	G-002	G-007	G-024	H-041	H-068	L-022
L-041	L-042	M-002	M-049	N-008	P-023	P-057	S-007
S-015	S-056	S-057	S-065	S-084	S-085	S-088	S-095
S-103	S-108	T-003	W-016	W-041	W-049	W-072	W-073
W-087							

Leakage

General Discussion

A-062	A-178	E-008	H-022	J-031	E-007	G-003	L-010
L-049	M-046	M-047	M-049	R-057			

Dynamic Seal Leakage

In Lip Seals

A-007	B-119	D-017	D-019	D-032	H-055	J-009	S-140

In Face Seals

A-123	A-231	B-073	B-101	B-112	B-130	C-038	D-009
D-027	F-034	G-001	H-055	H-066	H-067	M-007	M-039
M-040	M-042	M-043	M-062	S-004	S-039	S-132	T-003
T-042	T-057	W-024	W-053	W-085	W-091		

In Labyrinth Seals

A-007	A-018	B-023	B-112	C-038	D-020	D-069	F-034
F-045	G-043	H-033	H-059	H-067	J-013	K-009	K-011
K-036	K-044	L-047	M-018	M-019	M-093	P-013	R-044
S-024	S-120	V-004	V-005	V-006	W-009	W-013	W-067
Z-001							

In Packing or Stuffing Box

A-018	A-060	A-102	A-107	A-232	A-237	B-126	B-133
B-134	C-061	D-025	D-027	D-039	E-005	F-019	F-028
G-001	G-043	H-014	H-038	H-066	I-012	I-013	K-022
K-036	L-007	L-037	M-018	M-072	M-073	M-093	N-027
P-013	P-030	P-057	R-003	R-031	S-024	S-042	S-114
T-021	T-025	T-052	W-013	W-039	W-067	W-080	W-085

In "O" Rings

A-163	B-118	D-027	D-035	F-038	I-012	L-007	M-072
M-073	P-030						

In Dynamic Seals in General

A-011	A-068	A-107	A-136	A-137	A-156	A-233	B-014
B-025	B-054	B-066	B-073	B-080	B-112	B-132	C-009
D-027	D-032	D-034	E-005	E-036	F-009	F-034	G-026
G-030	H-006	H-007	H-017	H-021	H-035	H-046	H-047
H-077	I-012	K-027	K-042	K-044	L-007	L-008	M-007
M-013	M-093	N-015	N-027	P-007	P-030	P-055	S-005
S-024	S-104	S-119	T-028	T-042	U-002	W-009	W-039
W-053	W-073	W-076	W-080				

Leakage, Cont'd

Static Seal Leakage

A-004	A-156	B-009	B-049	B-062	B-118	C-016	C-049
E-029	F-028	F-042	H-038	H-071	K-001	K-010	M-062
M-092	M-107	N-015	N-019	S-064	S-086	V-001	W-039
W-043	W-047	W-053					

Leakage Test Techniques or Detection

A-014	E-033	H-034	H-064	K-010	K-036	P-027	S-064
Y-002							

Leakage by Molecular Diffusion or Permeation

B-043	B-077	D-008	D-014	H-020	J-030	J-031	L-050
M-033	P-001	P-055	R-015	R-057	S-081	W-076	

Leakage Testing Results

A-231	B-075	B-130	C-028	E-033	H-022	H-050	I-013
M-009	M-016	S-015	T-042				

Inverted Type - (Seal rotates with the shaft)

A-035	A-080	D-039

Loading and Sealing Characteristics - The installation or loading requirements and their influence upon seal life, wear, performance, etc. (Degree of compression tolerances, etc.)

A-006	A-033	A-069	A-223	B-039	B-118	B-124	C-005
C-081	D-040	E-024	E-028	E-034	F-039	H-060	I-013
K-037	K-038	M-031	M-053	M-055	P-023	R-039	R-061
S-034	S-036	S-054	S-078	S-082	S-139	V-009	W-041
W-058							

Lubrication

General

A-091	A-136	A-198	A-234	A-238	B-016	B-021	B-025
B-038	B-095	B-100	B-110	B-112	B-125	C-067	C-072
D-034	D-036	D-054	F-038	F-049	F-050	G-008	G-011
H-062	H-082	I-005	J-003	J-006	K-007	K-028	L-024
L-026	L-029	L-033	M-005	M-032	M-055	M-063	M-070
M-113	O-003	P-002	P-025	P-051	R-023	R-029	R-030
S-051	S-104	S-139	T-006	T-012	T-013	W-011	W-045
W-050	W-051	W-055	W-074	W-076	W-088		

In Lip Seals

B-063	F-031	J-007	J-008

In Face Seals

A-198	B-112	C-073	D-001	D-009	F-029	G-008	G-011
H-066	I-010	L-033	M-005	M-014	M-022	M-043	M-091
N-003	P-073	S-004	S-039	S-132	T-005	T-048	T-057

In Packings

A-091	A-198	C-063	C-065	F-029	H-066	M-006	M-032
M-104	P-041	S-095	T-048	W-004	W-072		

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Lubrication, Cont'd

Solid

A-028	A-052	A-053	A-085	A-098	A-239	B-035	B-041
B-061	B-093	C-067	E-001	G-020	G-034	H-026	H-048
K-001	L-036	M-013	M-041	N-018	N-020	O-004	P-016
P-043	R-008	R-062	S-061	S-138	T-001	U-001	

Lubricant Materials

A-119	A-184	A-239	B-055	B-056	B-110	B-125	C-077
D-034	D-036	E-014	F-009	F-031	G-004	G-028	H-010
H-066	H-080	R-065	K-012	K-015	K-016	K-022	K-025
K-035	L-017	L-029	L-042	M-095	M-006	M-032	M-042
M-058	M-065	P-028	P-037	P-039	R-060	S-025	S-033
S-071	T-013	V-012	W-076				

Magnetic

A-217	E-022	R-001	W-007	W-027

Manufacturing Methods

A-003	A-082	A-088	A-099	A-110	A-114	A-117	A-118
A-237	B-085	B-111	C-045	C-078	D-047	G-019	H-084
L-031	N-016	P-027	P-038	S-010			

Material Properties - (Mechanical and Physical)

of Elastomers (Buna-N, GR-S, Butyl, etc.)

A-169	B-043	B-083	C-031	D-053	E-010	F-048	K-012
M-106	N-020	P-037	S-141				

of Rubber (natural)

B-041	B-083	D-026	D-036	D-053	D-071	H-051	K-022
L-003	L-012	L-014	L-016	M-059	M-067	M-094	N-026
S-112	S-134	S-141					

of Rubber (synthetic)

A-093	A-134	A-143	A-154	A-158	A-168	A-169	A-185
B-083	D-071	H-020	L-014	L-016	M-097	M-098	O-004
P-031	S-124	W-054					

of Plastics (nylon)

A-046	B-083	C-031	M-106	P-039

of Metals

A-006	A-040	A-046	A-101	A-121	A-172	A-204	B-071
C-053	E-027	G-006	G-029	G-031	H-014	H-028	H-073
L-003	L-036	M-012	M-036	M-060	M-064	N-020	O-009
S-002	S-013	S-074	S-086	S-108	S-138	S-141	T-059
W-012	W-035	W-068					

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Material Properties -(Mechanical and Physical) Cont'd
of Other Materials

A-005	A-049	A-069	A-082	A-093	A-098	A-101	A-134
A-135	A-139	A-149	A-158	A-165	A-167	A-168	A-169
A-185	A-206	A-210	A-225	A-237	A-239	B-008	B-033
B-036	B-041	B-043	B-047	B-067	B-083	B-087	B-098
C-019	C-020	C-040	C-041	C-053	D-018	D-042	D-057
D-071	F-012	F-006	F-010	F-024	F-048	G-006	G-023
G-025	G-027	G-029	G-031	H-005	H-051	J-014	K-012
K-022	L-003	L-012	L-014	L-036	L-041	M-067	N-003
N-027	P-047	R-035	R-061	S-002	S-003	S-026	S-052
S-053	S-074	S-108	S-138	T-004	T-008	T-029	T-030
T-031	T-044	T-057	T-059	U-001	W-026	W-037	W-039
W-046	W-054	W-068					

Metallic

Gaskets

A-013	A-022	A-078	A-079	A-100	A-101	A-121	A-133
A-172	A-208	A-221	A-224	B-002	B-006	B-010	B-082
B-124	C-044	C-051	D-056	D-066	D-067	D-068	E-002
F-033	G-013	H-025	H-036	H-060	K-018	K-031	K-041
K-050	L-003	L-004	L-050	M-010	M-011	M-099	N-004
P-014	P-024	R-026	R-047	R-064	S-013	S-016	S-079
S-110	T-027	V-007	W-034	W-035	W-038	W-041	W-064
W-068	W-078	Y-002					

Piston Rings

D-048	P-015	P-058	S-037

Face Seals

A-174	B-028	H-079	M-103

General

A-004	A-013	A-025	A-052	A-058	A-067	A-097	A-103
A-130	A-162	A-174	A-178	A-202	A-207	A-236	B-028
B-040	B-071	B-075	B-083	C-007	C-051	C-052	C-080
D-007	D-046	D-048	D-072	E-027	F-008	F-019	F-026
F-028	G-009	G-013	H-014	H-022	H-031	H-032	H-036
H-038	H-054	H-073	J-012	J-023	J-025	K-006	K-023
K-040	K-050	L-010	L-040	L-049	L-050	M-010	M-020
M-045	M-066	M-071	M-074	M-103	M-108	N-007	N-011
N-013	O-002	P-015	P-058	R-036	R-037	R-040	R-053
S-037	S-041	S-063	S-127	S-129	V-002	W-003	W-012
W-015	W-020	W-029	W-034	W-043	W-052	W-062	W-072
Y-001							

Molding

A-131	A-239	A-169	A-020	A-125	B-008	B-094	C-029
C-035	C-045	C-013	D-071	E-001	E-026	F-030	J-027
M-059	M-106	M-112	N-017	P-036	P-037	P-038	P-041
S-007	S-097	S-126	S-138	T-001	W-069	W-080	

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Pressure above 5000 P.S.I.

A-040	A-130	A-147	A-171	A-183	A-230	B-001	B-036
B-050	B-057	B-089	B-099	B-103	D-003	E-009	E-035
F-010	F-039	G-012	G-021	H-079	J-017	J-023	L-007
L-016	M-030	M-069	N-015	P-008	P-015	S-019	S-068
S-111	T-039	W-042					

Pressure Transmission, Pressure Gradients

A-018	A-128	B-045	C-081	D-031	D-040	H-006	H-007
H-017	K-008	M-038	M-102	P-013	T-020	T-056	W-045
W-046	W-088						

Radiation Effects

A-188	B-053	B-098	B-106	H-004	K-015	N-020	T-049

Reciprocating Motion

General

A-058	A-072	A-083	A-147	A-148	A-217	A-220	B-028
B-029	B-030	B-050	B-073	B-088	B-117	B-119	C-034
C-057	D-003	D-027	D-032	D-034	D-064	F-003	F-011
G-028	I-009	I-012	J-004	J-022	J-023	J-024	K-044
M-048	N-027	R-052	S-089	S-109	T-011	T-058	U-003
W-009	W-029						

In "O" Rings

A-091	A-145	A-148	A-225	B-079	C-025	C-042	D-003
D-027	E-034	H-023	I-012	M-055	S-034	T-029	T-030
T-039	T-044						

In Packings

A-025	A-026	A-038	A-051	A-058	A-072	A-076	A-091
A-099	A-179	A-217	B-028	B-042	B-061	C-025	C-034
C-042	C-052	C-063	C-066	D-027	D-048	E-034	F-003
F-028	H-002	H-009	H-023	I-012	I-013	J-022	J-023
M-006	M-045	M-104	P-058	R-038	R-065	S-037	S-061
S-089	T-038	T-040	U-003	W-004	W-066	W-072	W-090

In Piston Rings

A-021	A-051	A-098	A-148	B-073	C-034	D-003	D-038
D-048	E-017	F-050	H-002	J-004	P-039	P-058	S-017
S-037	S-052	T-038	T-039	W-009			

Reliability and Service Life

A-032	A-038	A-049	A-085	A-122	A-125	A-128	A-195
C-032	G-039	H-020	H-037	H-063	K-025	M-062	M-077
M-084	M-109	N-010	R-002	S-052	T-035	W-043	

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Selection

"O" Rings

A-201	A-005	A-160	F-018	H-038	J-029	M-034	M-056
S-015	S-135						

Lip Seals

A-201	D-017	G-041	M-048	P-037	S-103

Face Seals

A-201	B-129	C-001	D-015	G-041	H-080	M-103	M-022
M-062	P-036	R-006	S-101	S-115	S-116	S-026	S-136
S-084	S-085						

Packings

A-042	A-201	B-049	B-109	B-129	C-001	C-032	D-045
D-049	D-060	F-018	F-028	G-041	H-038	H-039	H-063
I-002	K-049	L-032	L-046	M-020	M-034	N-008	P-029
P-036	R-031	S-135	S-067	S-071	W-083		

General

A-012	A-064	A-119	A-137	A-149	A-166	A-172	A-201
A-210	B-060	B-070	B-081	B-108	B-122	B-129	C-010
D-038	D-065	D-067	E-020	E-029	F-009	F-013	F-018
F-035	F-037	I-008	K-016	K-047	K-049	L-011	M-015
M-034	M-103	N-019	P-016	P-022	P-023	P-037	P-051
R-025	S-015	S-038	S-080	S-096	S-101	S-102	S-135
T-034	W-026	W-040	W-041	W-074	W-078		

Shaft Eccentricity, Misalighment, Whirl, Vibration, Whip

A-005	A-009	A-038	A-051	A-136	B-016	B-069	B-072
C-063	D-008	D-018	D-025	D-035	H-050	H-077	I-005
J-019	M-036	M-062	M-091	N-005	N-012	S-040	S-048
S-104	T-005	W-007					

Shaft Surface Finish and Hardness

A-004	A-005	A-015	A-091	A-107	A-120	A-121	A-174
A-209	B-035	B-108	B-129	C-023	C-025	C-063	D-003
D-009	D-017	D-018	D-026	E-020	E-027	F-010	G-019
G-023	G-026	G-028	H-041	H-055	H-075	H-077	J-010
J-011	J-023	K-001	K-017	M-034	M-053	M-055	P-008
S-026	S-036	S-068	S-116	S-130	S-141	S-142	T-009
W-039	W-040	W-058	W-080				

Speed, High - (Greater than 4000 fpm)

A-009	A-166	A-212	B-005	B-030	B-091	B-097	C-046
C-054	E-021	E-022	F-034	F-047	G-027	G-034	M-003
M-023	M-052	M-053	O-005	P-022	R-031	R-034	R-048
S-033	S-053	S-058	S-060	S-075	S-122	T-003	T-010
W-051	W-055	W-071	W-074	W-081			

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Spring Loaded Types

Face Seals

In Aircraft Sealing, Fuel Tanks, Airframes

B-013 H-079 S-115

in Launch Vehicle Sealing (Rockets, Missiles)

C-054 H-003

in Hydraulic Equipment Sealing

A-217 I-006 S-028 S-117 T-043

In vacuum Sealing

A-170 C-075 H-064 S-055 W-081

Lip Seals

B-120 F-020 G-032 G-041 H-055 H-084 I-006 R-062
S-093

Segmental Rings

A-035 B-120 C-075 D-027 S-040

"O" Rings

B-079 B-090 C-041 D-027 D-062 G-008 H-064 K-012

General

A-037	A-041	A-055	A-068	A-094	A-096	A-102	A-107
A-112	A-127	A-128	A-137	A-140	A-198	A-217	A-230
A-240	B-069	B-072	B-073	B-074	B-090	B-112	B-120
C-001	C-002	C-038	C-048	C-066	C-075	D-027	D-043
D-044	D-062	E-001	E-020	F-005	F-028	F-029	F-034
G-001	G-011	G-032	G-037	G-041	H-064	H-066	H-067
J-022	K-005	L-020	L-021	L-033	M-005	M-007	M-013
M-033	N-027	P-036	P-049	P-054	R-036	R-062	S-011
S-028	S-040	S-050	S-073	S-093	S-101	S-110	S-117
S-131	S-136	T-016	T-021	W-053	W-084	W-085	W-087

Standards in Sealing

A-048	A-074	A-095	A-229	B-122	F-009	H-053	H-084
L-003	M-015	M-061	O-001	S-009	S-030	S-067	S-119
T-023	W-001						

Stresses in Sealing Elements

A-006	A-153	A-154	B-032	B-033	B-035	B-045	E-003
E-011	F-048	H-055	K-021	K-037	L-014	L-038	M-041
M-056	M-106	N-020	N-026	O-001	P-014	R-023	R-061
S-003	S-081	S-082	S-099	S-139	T-020	T-059	V-009
W-022	W-040	W-041	W-058				

SPECIFIC INTEREST AREAS IN SEALING, CONT'D

Suspended Solids and Abrasives in Fluids

A-217	A-220	F-029	R-001	J-011	L-036	N-023	N-024
N-025	P-053	R-001	W-005	W-007	W-009	W-058	

Temperature Below -65°F

A-015	A-135	A-191	A-216	B-010	B-036	B-059	B-124
C-029	E-034	E-035	H-030	H-032	H-081	I-011	K-046
K-048	K-052	L-017	L-018	L-038	L-045	M-013	M-101
P-028	R-042	S-012	S-033	S-046	S-094	S-116	T-046
W-006	W-030	W-038	W-054	W-070	W-071	W-081	

Temperature Above +1000°F

A-015	A-097	A-133	A-202	A-204	A-205	A-207	B-057
B-097	B-124	B-125	C-007	C-053	E-024	F-017	G-027
G-031	H-060	H-082	M-003	M-016	N-020	O-006	S-053
S-116							

Testing, Specification, Evaluation, Performance

of Lip Seals

A-118	A-203	B-052	C-017	D-032	D-029	F-020	F-031
H-050	I-003	J-008	J-011	P-017	R-062	S-140	S-141

of Face Seals

A-231	B-072	B-074	B-097	C-053	C-054	C-038	D-001
D-015	E-028	F-015	G-034	G-034	I-010	L-033	L-036
M-014	M-023	M-039	M-091	M-095	N-003	N-024	O-005
P-017	R-048	R-062	S-018	S-021	S-026	S-055	S-084
S-132	T-043	W-024	W-057				

Packings or Stuffing Box

A-023	A-060	A-143	A-150	A-171	A-179	A-203	B-026
B-047	B-072	B-074	B-075	B-103	B-105	C-003	C-024
D-025	D-028	D-039	D-040	D-045	D-063	F-019	F-025
G-014	G-029	G-036	H-024	H-054	H-056	K-037	K-050
M-038	M-059	M-072	N-027	P-017	P-030	P-046	R-001
R-007	S-031	S-032	S-069	S-088	S-106	S-124	T-008
T-025	T-050	T-056	U-004	W-018	W-046	W-067	W-080

Gaskets

A-088	A-121	A-133	A-141	A-204	A-210	B-002	B-046
B-047	B-082	B-106	C-017	C-044	D-056	E-028	E-033
G-004	H-005	H-037	H-044	H-081	K-048	K-050	N-019
N-022	O-001	O-008	R-028	R-045	S-046	S-054	S-077
S-110	S-137	T-026	V-009				

"O" Rings

A-143	A-153	A-160	A-169	A-187	A-216	B-064	B-079
B-090	B-105	B-118	C-017	C-023	C-024	C-068	D-029
D-062	D-063	E-013	G-005	G-015	H-024	K-025	L-029
M-052	M-053	M-059	M-072	N-026	O-001	P-001	P-030
S-034	S-035	S-124	S-125	S-126	S-137	T-031	U-004
W-025	W-077						

Testing, Specification, Evaluation, Performance, Cont'd

of Bushings

A-199 B-081 B-091 D-008 F-046 R-029 V-010

of Segmental Rings

A-226 B-097

of Freeze Seals

C-037 C-079 C-081 S-006 S-127

of Felt, Quad, Delta, X, or other Cross Sections of Rings

C-015 E-024 H-041 P-030 W-010 W-062

of "V" Rings

A-041 A-216 C-023 D-063 E-024 S-069

of Piston Rings

B-086 D-063 K-017 S-073 T-009 W-009 W-010 W-025

Labyrinth Seals

A-226 C-038 D-020 D-069 E-007 H-033 H-059 K-009
K-011 S-088 S-120 T-037 T-050 V-004 W-009 W-067

of Hydraulic Equipment, Sealing

A-149 A-154 A-158 A-161 A-164 A-216 B-047 B-051
B-056 B-085 C-007 C-008 C-024 C-058 C-059 D-062
F-027 G-002 G-019 G-036 H-022 H-078 J-010 K-017
L-006 M-012 M-021 M-044 M-084 M-085 P-003 R-024
S-023 W-025

of Vacuum Seals

B-104 H-031 K-040 U-002 W-031 W-043 Y-001

of Valve Seals

B-051 C-081 H-021 M-021 S-006 T-022 U-002 W-080
Y-001

Theoretical or Analytical Evaluation

of Labyrinth Seals

A-059 A-226 B-129 D-055 E-007 G-016 G-017 G-043
H-059 K-008 K-009 M-018 M-019 M-102 P-021 S-088
S-120 T-053 V-004 V-006 Z-001

of Bushings

B-091 D-008 F-014 J-003 R-058 S-048 S-104 T-053

of Screw Seals

A-233 A-235 B-074 R-058 R-059 Z-002

Theoretical or Analytical Evaluation, Cont'd
of Face Seals

B-074	B-101	B-128	B-129	D-009	F-024	H-055	I-006
L-019	L-033	L-048	M-039	N-005	S-004	T-005	

General

A-002	A-006	A-059	A-084	A-136	A-226	A-234	B-003
B-004	B-016	B-038	B-045	B-063	B-074	B-095	B-096
B-100	B-129	C-005	C-069	D-013	D-023	D-030	D-040
D-054	D-064	G-016	G-040	G-043	G-045	H-006	H-007
H-017	H-055	H-077	I-003	I-006	K-007	K-021	K-038
K-043	K-053	L-024	L-026	L-027	L-033	M-018	M-052
M-079	M-080	M-100	M- 02	N-011	N-015	N-019	O-003
P-002	P-008	P-020	P-034	P-055	R-021	R-022	R-023
R-037	S-003	S-005	S-032	S-068	S-083	S-088	T-004
T-006	T-012	T-014	T-019	T-020	T-053	T-056	T-058
W-011	W-022	W-041	W-043	W-045	W-047	W-050	W-065
W-074	W-088	W-089					

Thermal Effects

A-009	A-158	A-208	A-237	B-096	G-006	H-068	H-073
J-019	J-020	J-026	J-027	K-052	L-023	L-038	M-041
M-094	N-020	O-009	R-055	S-053	T-059	U-001	W-048

Wear and Wear Particles

A-120	A-238	B-013	B-126	C-046	E-017	E-022	G-023
H-014	H-077	H-082	J-011	J-020	L-023	L-029	M-006
M-040	M-062	M-081	N-023	P-034	P-045	S-061	S-112
T-001	T-010	T-060	W-007	W-009	W-080		

Wear Due to Rubbing

A-098	A-128	B-005	B-016	B-018	B-033	B-125	C-041
C-057	C-067	D-039	F-046	G-027	K-044	L-036	M-003
M-023	N-012	N-027	S-020	S-053	S-074	S-132	S-138
T-020	W-012	W-069	W-071	W-074			

III. SEALING MATERIALS

Asbestos and Asbestos Compositions

A-039	A-051	A-052	A-053	A-064	A-065	A-066	A-067
A-101	A-113	A-132	A-133	A-134	A-141	A-241	B-060
B-071	B-109	C-032	D-005	D-048	D-056	D-066	F-003
F-018	F-022	G-029	H-005	H-052	H-083	J-022	K-018
K-049	L-003	L-011	L-014	M-030	N-016	P-018	P-041
P-056	R-024	R-045	S-130	T-001	T-008	T-018	T-025
T-026	U-003	V-007	W-039	W-041			

Carbon and Graphites

A-028	A-036	A-041	A-044	A-052	A-053	A-063	A-064
A-070	A-082	A-098	A-104	A-108	A-114	A-158	A-174
A-239	B-005	B-007	B-028	B-030	B-035	B-041	B-052
B-058	B-061	B-093	B-109	B-110	B-128	B-129	C-067
C-075	D-001	E-001	E-026	F-024	G-006	G-007	G-020
G-034	H-048	H-082	J-020	K-001	K-027	K-035	K-046
K-049	L-036	M-002	M-013	M-041	M-081	M-091	M-111
N-018	P-016	P-043	P-053	P-056	R-008	R-027	R-062
S-024	S-038	S-061	S-073	S-138	T-001	T-011	T-021
U-001	W-029	W-059	W-069	W-071			

Cements, Lutings and Adhesives

A-001	A-188	A-216	B-067	B-106	B-123	K-052	P-006

Ceramics and Cermets

B-125	C-051	C-053	C-071	E-002	G-007	G-027	G-031
H-080	H-082	M-022	S-053	S-098	W-069		

Cork and Cork Compositions

A-051	A-064	A-113	A-134	A-141	A-241	B-046	C-032
E-026	F-036	H-019	H-051	K-018	K-049	L-014	P-056
T-026	V-007	W-078					

Felt

A-064	A-112	A-113	A-167	B-023	B-066	B-023	C-032
G-025	K-018	M-015	M-086	P-007	R-001	R-035	S-002
S-093	S-101	T-018	W-014	W-020	W-078		

Fibers

A-039	A-064	A-065	A-066	A-070	A-086	A-088	A-132
A-134	A-141	B-026	B-078	C-032	F-022	F-036	G-025
K-018	K-022	K-039	K-049	L-003	L-014	L-042	M-006
M-020	M-030	M-104	N-018	P-041	P-058	R-037	S-113
S-130	S-135	T-001	T-007	T-018	T-039	T-058	U-003
V-007	W-047						

Glass and Glass Fibers

A-002	A-003	B-052	B-125	D-010	D-041	D-061	E-002
F-041	G-009	G-025	G-035	H-074	H-080	K-045	L-045
M-017	M-022	M-090	R-032	S-008	S-043	S-072	S-074
S-108	T-001	T-007	T-059	W-028	W-069		

SEALING MATERIALS, CONT'D

Leathers

A-051	A-055	A-064	A-067	A-099	A-113	A-141	B-011
B-031	B-042	B-043	B-131	C-032	C-078	D-004	D-052
D-058	D-060	E-032	F-031	G-028	H-056	H-069	H-070
H-083	J-032	K-018	K-049	L-012	M-024	M-027	M-029
M-033	P-017	R-004	R-005	R-006	R-007	S-051	S-057
S-065	S-066	S-070	S-090	S-101	T-002	T-018	T-039
W-032							

Metallic Seals

Aluminum

A-064	A-071	A-078	A-121	A-208	A-221	B-124	C-051
E-027	F-033	H-054	H-060	H-071	H-072	H-081	K-049
M-016	P-041	R-064	S-062	S-079	S-094	W-002	Y-002

Brass

A-064	B-069	E-015	K-052	R-040

Bronze

A-064	C-042	E-032	K-049	M-022	P-015	R-036	T-009
T-040							

Ferrous Alloys

A-081	A-103	A-130	A-133	A-202	A-208	A-220	B-002
B-005	B-054	B-124	C-007	C-016	C-067	D-003	D-066
E-002	E-003	E-024	E-027	F-019	F-026	G-019	H-031
H-060	H-082	K-001	K-041	K-046	K-047	K-052	L-004
L-043	L-045	M-003	M-012	M-024	M-081	N-004	N-012
N-016	P-024	R-036	R-047	R-051	S-002	S-016	S-062
S-079	S-086	S-108	S-113	S-138	S-141	S-142	T-009
W-007	W-064	Y-002					

Metal Fiber Composites

A-019	A-028	A-040	A-052	A-066	A-070	A-101	A-133
A-204	A-205	A-207	B-071	D-066	F-022	H-028	P-041
R-007	R-045	S-002	S-074	S-086	S-130	V-007	

Plated Metal Coatings

A-015	A-130	A-192	B-002	B-100	C-067	E-024	J-020
M-081	S-016						

Other Metal and Alloys

Used in Face Seals

A-174	B-028	B-030	B-059	B-129	C-053	D-001	G-008
G-034	H-079	L-036	M-022	M-023	M-041	M-103	P-017
R-062	S-018	S-033	S-101	S-116	S-118	T-003	

Metallic Seals, Cont'd

Other Metal and Alloys, cont'd

Used in Gaskets

A-013	A-022	A-064	A-065	A-066	A-078	A-079	A-085
A-100	A-101	A-172	A-224	B-002	B-006	B-010	B-082
B-124	C-044	C-051	C-071	D-056	D-067	D-068	E-002
E-006	E-031	F-033	G-013	G-035	H-025	H-036	H-072
H-074	H-081	J-004	K-018	K-031	K-048	K-049	K-050
K-051	L-001	L-003	L-038	L-045	L-050	M-010	M-011
M-016	M-060	M-099	M-107	N-004	P-014	P-024	P-040
R-026	R-045	R-047	R-064	S-013	S-110	S-113	S-130
T-018	T-027	V-001	V-007	W-034	W-035	W-038	W-041
W-068	W-078	Y-002					

Used in "O" Rings

A-013	A-015	A-236	B-079	C-025	D-010	D-062	E-014
F-018	G-008	G-013	H-036	H-038	H-083	J-002	J-025
K-051	K-052	L-029	M-017	M-108	P-015	P-040	P-032
R-041	R-053	S-041	S-072	S-118	U-002	W-015	

Used in Other Ring Seals

A-037	A-058	A-072	A-075	E-024	J-021	L-010	L-050
M-010	S-069	W-027	W-062				

Used in Packings

A-019	A-020	A-023	A-024	A-025	A-028	A-032	A-037
A-038	A-039	A-046	A-050	A-052	A-058	A-061	A-065
A-067	A-072	A-075	A-097	B-026	B-028	B-040	B-071
B-075	B-109	B-129	C-025	C-052	D-004	D-046	D-048
F-007	F-016	F-018	F-022	F-025	F-028	G-009	G-029
H-008	H-009	H-014	H-038	H-042	H-083	J-012	J-021
J-022	J-023	K-006	K-023	K-049	K-050	L-040	M-006
M-020	M-045	M-066	M-093	M-104	N-018	O-002	O-009
P-017	P-041	P-058	R-036	R-037	S-037	S-069	S-118
S-129	T-018	T-040	W-003	W-012	W-034	W-052	W-072

Used in Piston Rings

D-038	D-048	H-012	J-002	J-004	K-017	P-015	P-017
P-056	P-058	S-037	S-040	S-118	T-009		

Used in Other Seals

A-004	A-006	A-066	A-106	A-162	A-174	A-178	A-192
A-202	A-205	A-207	B-018	B-050	B-125	B-129	C-007
C-008	C-051	C-080	D-007	E-024	F-008	G-006	G-028
G-031	H-013	H-022	H-031	H-032	H-061	H-073	H-075
H-078	J-020	J-022	J-023	K-039	K-040	K-050	L-010
L-028	L-045	L-049	M-012	M-036	M-064	M-071	M-074
M-093	M-103	N-007	N-011	N-013	N-020	O-009	P-017
P-056	R-018	R-024	R-055	R-062	S-002	S-008	S-018
S-040	S-063	S-086	S-101	S-127	T-036	T-059	W-005
W-020	W-029	W-043	W-048	W-065	W-069	W-071	W-079
Y-001							

SEALING MATERIALS CONT'D

Organic, Synthetic Materials

Chloroprene (Neoprene)

A-075	A-076	A-080	A-082	A-161	A-241	B-057	B-083
B-100	B-104	B-106	C-056	C-077	D-014	D-071	E-011
E-013	E-031	F-025	H-026	H-027	H-044	H-058	J-031
K-012	K-025	K-037	L-017	L-038	M-058	N-022	P-030
P-041	P-046	S-123	Y-002	Y-004			

Elastomers (Buna-N, GR-S, Butyl, etc.)

In Face Seals

M-106	P-037	S-141

In Gaskets

A-001	A-081	A-215	B-115	E-010	E-011	J-027	K-033
N-016	P-040						

In "O" Rings

A-153	A-169	A-187	B-079	C-012	C-024	D-062	E-014
F-048	J-027	K-012	P-040	R-018	S-125	T-045	T-046
T-049							

In Packings

C-013	C-024	C-031	D-053	K-033	N-016	P-038	P-046
W-018							

In Other Seals

B-043	B-055	B-056	B-083	B-084	B-085	B-086	B-088
B-104	C-008	C-024	C-070	D-062	D-070	E-014	G-028
G-033	G-038	H-018	H-047	H-071	J-005	J-026	J-027
K-017	K-039	L-017	L-018	L-028	L-039	M-113	N-016
N-020	P-006	P-037	R-018	R-033	S-091	S-092	W-030
W-031							

Fluoro-Elastomers (Kel-F, Teflon, Viton)

In Gaskets

A-135	A-167	A-215	B-047	B-106	C-044	F-026	F-033
G-004	G-018	G-021	H-064	H-074	H-081	K-033	M-067
M-068	N-022	P-040	S-107	S-108	S-130	Y-002	

In Lip Seals

B-052	G-022	G-032	S-070

In "O" Rings

A-165	A-169	A-190	A-197	B-064	B-090	B-118	C-041
E-014	E-034	F-048	G-003	G-022	H-011	H-030	H-038
H-064	P-040	P-047	R-001	S-070	Y-004		

SEALING MATERIALS CONT'D

Organic, Synthetic Materials Cont'd

Fluoro-Elastomers (Kel-F, Teflon, Viton) Cont'd

In Other Seals

A-122	A-125	A-126	A-127	A-135	A-161	A-168	A-184
A-185	A-206	A-237	B-012	B-036	B-047	B-051	B-054
B-061	B-078	B-089	B-090	C-077	D-004	D-006	E-001
E-014	E-024	E-026	E-034	F-021	F-022	G-003	G-018
G-021	G-022	G-023	G-032	G-033	H-038	H-064	H-080
J-030	J-031	K-033	L-039	M-067	M-068	M-101	N-012
P-046	P-054	R-001	R-015	S-017	S-070	S-111	S-117
S-139	T-001	T-007	W-019	W-031	W-069	W-080	

Plastics (Nylon etc.) Used in

Gaskets

A-064	A-088	A-141	A-157	C-044	E-026	H-068	K-018
P-012	P-014	R-042	S-107				

"O" Rings

A-236	C-012	R-054

Lip Seals

M-106

Other Seals

A-028	A-029	A-039	A-046	A-052	A-108	A-124	A-131
A-159	B-012	B-078	B-083	C-004	C-024	C-027	C-031
C-077	E-026	H-068	L-028	M-041	N-012	P-039	P-041
S-008	S-062	S-069	S-117	T-007	T-036	W-031	W-071

Silicones

A-093	A-158	A-211	A-215	B-051	B-060	B-126	C-011
C-029	C-070	C-077	D-071	E-003	E-013	E-026	E-034
E-035	F-017	F-021	G-004	G-032	G-033	H-004	H-068
H-081	I-011	J-031	K-012	K-035	L-039	M-058	M-082
N-022	P-001	P-006	P-038	P-040	R-041	S-130	T-033
T-034	W-054						

Rubber, Natural Used in

Gaskets

A-033	A-064	A-065	A-074	A-085	A-141	A-208	A-241
B-116	B-117	C-044	D-014	D-056	E-031	F-032	F-033
F-039	F-041	G-013	H-037	J-027	K-018	L-003	L-014
M-067	M-082	P-040	S-130	T-018	U-003	V-007	V-011
W-033	W-063	W-078					

Lip Seals

B-052	J-002	R-004	S-057	S-058	S-070	S-093	S-112
S-141							

SEALING MATERIALS CONT'D

Rubber, Natural Used in

"O" Rings

A-222	A-236	B-064	C-024	C-045	D-035	D-071	F-039
G-003	G-013	J-002	J-017	J-027	K-002	K-025	K-052
M-059	N-026	P-040	R-001	S-070	S-118	T-039	Y-004
Y-005							

Packings

A-016	A-065	A-070	A-074	A-099	A-222	A-228	B-026
B-028	B-041	B-109	C-024	C-032	D-053	F-003	F-022
H-051	H-052	K-022	M-059	M-067	M-094	P-018	P-041
R-001	S-010	S-061	S-069	S-070	S-118	T-018	U-003

Other Seals

A-074	A-159	A-184	B-009	B-019	B-028	B-032	B-083
B-117	C-024	D-022	D-026	D-036	D-041	F-003	F-039
F-043	F-051	G-003	H-041	H-062	J-002	J-005	J-017
J-027	K-039	L-012	L-016	M-062	M-103	M-111	P-056
R-006	S-062	S-069	S-070	S-092	S-093	S-118	S-123
S-134	T-039	T-058	W-027	W-031	W-075	Y-001	

Rubber, Synthetic - (A specific synthetic compound is not stated) Used In

Gaskets

A-008	A-081	A-093	A-132	A-134	A-215	A-221	B-106
E-026	F-036	H-020	H-068	K-018	K-048	L-014	M-097
M-098	O-008	R-009	S-097	S-033	W-054		

Lip Seals

A-118	A-189	B-011	C-057	F-031	G-032	J-007	J-008
S-103							

"O" Rings

A-143	A-169	C-011	C-012	C-024	D-027	D-071	D-072
E-013	G-015	H-023	M-028	M-052	P-001	R-041	S-030
S-035	S-124	V-003	W-054				

Packings

A-143	C-013	C-024	D-004	D-027	D-050	D-051	D-052
E-026	G-032	H-023	H-068	M-028	M-030	M-032	R-003
S-071	S-124						

Other Seals

A-154	A-158	A-159	A-161	A-168	A-185	A-200	A-211
B-032	B-078	B-083	B-085	B-104	C-024	C-029	C-077
D-027	F-026	F-009	F-017	F-021	F-030	F-042	G-033
I-004	I-005	J-026	J-030	J-031	L-013	L-016	M-030
M-032	M-086	M-101	M-103	O-004	P-031	P-056	R-005
R-006	S-101	S-122	T-022	T-033	T-034	V-003	W-005
W-019	W-031	W-054					

IV. APPLICATIONS

Aircraft Jet Engines

B-067	B-097	C-046	G-034	S-073	T-010

Aircraft Sealing - (fuel tanks, airframes, canopies, etc.)

Face Seals

B-013	B-034	H-079	S-115

Packings

A-152	C-013	C-025	C-039	D-021	G-036	H-024	K-022
M-026	M-059	M-072	M-073	P-046	S-066	S-106	T-038

Gaskets

A-078	A-088	A-221	G-004	M-082	P-012	R-045	W-026

"O" Rings

A-151	A-187	A-190	B-064	C-025	C-039	D-021	F-048
G-003	H-024	M-059	M-072	M-073	P-009	P-047	R-018
R-053	S-125	S-126					

General

A-090	A-111	A-117	A-131	A-164	A-166	A-185	B-018
B-055	B-056	B-111	C-009	C-029	C-055	F-008	G-003
G-036	H-022	H-043	I-011	J-020	K-013	K-014	K-016
K-017	K-029	K-045	L-005	L-016	L-018	L-039	M-026
M-036	M-054	M-071	M-084	P-003	P-005	P-011	P-031
R-002	R-018	R-019	R-060	S-062	S-091	S-138	T-022
T-037	T-038	W-026	W-028				

Automobile Sealing

A-081	A-096	A-179	A-222	B-011	B-033	B-046	B-085
B-086	C-006	C-021	C-039	C-070	E-028	G-032	G-033
H-049	H-075	L-012	L-031	R-004	R-043	S-040	S-057
S-100	S-122	S-140	V-003				

Bearing Sealing

Face Seals

B-120	C-006	F-034	G-008	G-041	H-067	M-014	M-086
P-017	S-093						

Packings

A-047	A-051	A-099	A-102	B-048	C-006	E-032	G-041
P-017							

"O" Ring

G-008

APPLICATIONS, CONT'D

Bearing Sealing, Cont'd

General

A-048	A-051	A-057	A-068	A-112	A-113	A-129	A-136
A-173	A-189	B-016	B-023	B-025	B-066	B-069	B-096
B-114	B-120	B-121	B-122	C-006	C-033	E-032	F-021
F-023	F-034	G-041	G-042	H-048	H-049	H-053	H-067
J-009	K-042	L-009	M-008	M-015	M-070	P-007	P-017
P-025	P-056	R-025	R-030	S-040	S-048	S-093	S-096
S-100	S-102	S-103	S-128	W-020	W-051	W-056	

Chemical Industry Sealing

A-056	A-061	A-106	A-109	A-116	A-128	A-184	A-202
A-215	A-230	B-027	B-057	B-071	B-075	C-027	C-063
D-015	D-016	D-043	D-044	D-046	G-001	H-029	H-080
K-034	K-038	K-046	K-047	K-053	L-042	M-039	M-077
M-083	N-014	O-004	P-023	P-050	P-051	P-052	P-053
R-014	R-048	R-051	S-011	S-021	S-044	S-107	S-111
S-130	S-136	T-016	T-047	T-048	W-007	W-041	W-060
W-081	W-091						

Compressor, Sealing

A-076	A-098	A-106	A-109	A-137	A-193	A-194	A-198
A-199	B-084	C-074	C-075	D-045	F-003	G-034	J-013
M-063	M-078	M-104	O-007	P-042	S-027	S-036	S-049
S-050	S-052	T-048	V-006	W-009	W-029	W-059	W-066
W-072							

Cryogenic Fluid, Sealing

A-216	B-059	B-061	E-003	E-014	H-012	H-028	H-030
H-032	H-081	K-052	L-017	L-038	L-045	P-028	R-042
S-046	S-074	S-094	T-046	W-006	W-030	W-031	W-038
W-069	W-070	W-071	Y-002				

Engines, Internal Combustion and Diesel

A-078	A-079	A-094	A-179	A-187	B-119	D-053	E-013
E-033	F-044	H-041	H-084	K-049	L-031	N-010	N-016
P-031	R-065	S-017	S-027	S-052	S-079	T-017	T-050

Electric Machine, Sealing

A-102	A-119	A-195	A-217	B-023	C-072	C-073	G-005
G-042	K-007	K-039	M-014	M-063	M-082	P-026	W-007

Electrical Cable Entry Gland, Terminals, etc.

A-131	D-041	F-051	G-045	H-027

Electronic Tube Sealing

P-024	P-027

Equipment - (electrical, electronic, etc.)

A-008	A-221	A-241	B-111	C-020	F-013	H-019	H-020
M-011	M-082	M-108	W-024				

APPLICATIONS, CONT'D

Exclusion Sealing

A-056	A-068	A-102	A-112	A-214	B-066	B-069	B-070
E-032	I-009	K-042	L-008	M-048	M-086	S-096	S-100
S-102	S-103						

Hose and Pipe Connections and Quick Disconnects

A-006	A-053	A-069	A-077	A-085	A-115	A-164	A-175
A-191	A-216	A-221	B-049	B-064	C-003	C-004	C-005
C-014	C-015	C-016	C-037	C-055	C-058	C-059	C-064
A-068	C-072	D-005	D-010	D-041	D-061	D-072	E-003
E-029	F-004	F-016	G-005	G-010	G-019	G-029	H-024
H-036	H-038	H-054	H-058	J-014	K-020	K-030	K-041
K-048	M-017	M-047	M-060	P-014	P-033	P-040	R-002
R-015	R-016	R-060	S-008	S-016	S-030	T-008	T-055
W-001	W-026	W-034	W-035	W-036	W-048	W-064	W-068

Hydrogen-Cooled Generators and Motors, Sealing

B-020	B-022	B-024	G-008	H-067	K-028	M-014	P-055
P-073	R-029						

Hydraulic Equipment, Sealing

Packings

A-026	A-039	A-060	A-091	A-095	A-099	A-105	A-143
A-150	A-152	A-176	A-179	A-217	B-008	B-047	B-105
C-013	C-024	C-025	C-034	C-039	C-060	C-061	C-078
D-004	D-021	D-049	D-058	D-059	D-060	E-015	F-018
F-025	F-028	G-032	G-036	H-023	H-024	H-038	H-056
H-083	J-010	J-032	K-022	L-032	M-020	M-025	M-026
M-027	M-034	M-051	M-059	M-072	M-096	N-021	P-029
P-038	P-046	R-007	R-017	R-020	S-028	S-066	S-067
S-070	S-071	S-089	S-090	S-106	S-117	S-118	S-124
S-135	T-002	T-038	T-060	U-004	W-034		

Gaskets

A-008	A-105	B-047	C-017	D-065	K-048	P-012	R-017
S-089	W-026	W-034	W-035				

"O" Rings

A-091	A-143	A-153	A-165	A-169	A-176	A-190	A-216
B-008	B-064	B-079	B-105	B-118	C-005	C-011	C-017
C-024	C-025	C-039	C-045	C-060	D-021	D-035	D-062
E-014	F-018	F-038	G-003	H-004	H-023	H-024	H-038
H-083	J-015	K-012	K-025	M-034	M-050	M-051	M-053
M-057	M-059	M-072	P-008	P-009	P-019	P-020	P-035
P-047	R-018	S-070	S-118	S-124	S-125	S-126	S-135
U-004	V-003	W-006	W-015	W-016	W-025		

Face Seals

A-217	I-006	S-028	S-117	S-118	T-043

APPLICATIONS, CONT'D

Hydraulic Equipment, Sealing, Cont'd

"V" Ring, "U" Ring, Quad, Delta X, or Other Cross Sections of Rings

A-090	A-095	A-176	A-216	B-047	C-024	C-034	D-058
F-018	F-027	G-003	G-036	J-032	M-026	M-027	M-034
S-070	S-090	S-135	V-003	W-016			

Lip Seal

B-011	C-017	C-057	D-018	G-032	H-084	I-006	I-009
T-035	W-017						

General

A-012	A-014	A-086	A-096	A-111	A-149	A-154	A-158
A-161	A-162	A-164	A-168	A-184	B-017	B-029	B-031
B-035	B-051	B-053	B-055	B-056	B-078	B-085	C-004
C-007	C-008	C-021	C-055	C-058	C-059	C-070	C-072
C-077	D-033	D-038	D-062	E-014	E-036	G-002	G-019
G-033	H-001	H-006	H-007	H-022	H-062	H-078	J-010
K-013	K-014	K-015	K-016	K-017	L-005	L-006	L-016
L-027	L-049	M-012	M-021	M-044	M-051	M-054	M-058
M-071	M-084	M-085	M-101	P-003	P-008	P-011	P-054
R-018	R-019	R-024	R-060	S-023	S-118	S-121	S-134
T-002	T-009	T-032	T-038	V-012	W-025	W-026	W-092

Instruments, Precision - (Optical and Electrical)

A-214	B-012	E-004	R-042	W-019

Iron and Steel Industry, Sealing

A-024	A-040	A-124	A-127	A-209	D-033	F-020	J-032
K-039	K-042	M-109	P-017	R-033	S-121	W-056	

Launch Vehicle Sealing - (Rockets, Missiles)

A-175	A-178	A-236	B-019	B-044	B-051	B-059	C-054
D-007	E-003	E-014	H-003	J-025	K-013	K-017	L-039
M-036	M-106	P-004	P-028	R-002	R-018	V-008	W-062
W-069	W-073						

Liquid Metal Sealing

A-007	A-156	A-181	B-003	C-037	C-038	C-080	C-081
E-024	G-014	G-020	H-046	K-040	M-074	N-007	S-006
S-018	S-127	T-042					

Mixers and Agitators, Sealing

A-122	B-027	B-060	D-043	G-030	M-083	N-012	R-051
T-048							

Munitions Sealing

F-025	O-008	R-007	S-003	S-106	W-037

Naval Ships (Submarines)

A-070	A-078	A-228	C-037	C-058	E-013	H-002	H-037
M-061	R-025	T-018	S-014	W-075			

APPLICATIONS, CONT'D

Nuclear Plant, Sealing

A-007	A-156	A-193	A-194	A-195	A-199	A-211	A-213
A-223	B-080	B-081	B-084	B-115	C-028	C-037	C-050
G-020	G-030	H-004	H-035	H-045	H-046	H-047	H-076
J-019	K-001	K-010	K-040	K-050	M-008	M-014	M-046
M-087	P-001	R-052	S-006	S-012	S-039	S-063	S-127
W-051	W-057	W-075	S-076	W-077	Y-003		

Petroleum, Petrochemical Industries Sealing

A-047	A-048	A-055	A-068	A-082	A-083	A-108	A-110
A-118	A-144	A-159	A-185	A-203	A-206	A-221	B-025
B-048	B-049	B-062	B-092	B-110	B-119	C-010	C-054
C-056	D-001	D-015	D-027	D-035	D-066	F-005	F-009
F-020	F-023	F-030	F-031	F-032	F-034	F-048	H-049
H-050	H-055	H-069	H-080	H-084	I-003	I-008	J-007
J-008	J-028	K-021	K-034	L-008	L-017	L-019	L-025
L-031	L-044	M-029	M-086	M-113	N-017	P-007	P-030
P-037	P-038	P-049	R-005	R-012	S-051	S-061	S-096
S-099	S-100	S-102	S-103	S-114	S-122	S-140	T-004
T-015	T-016	T-022	T-049	V-012	W-008	W-012	W-073
W-082	W-087						

Pneumatic Equipment Sealing

A-010	A-032	A-098	A-106	A-152	A-160	A-164	A-176
A-194	A-199	A-239	B-031	B-042	B-051	B-064	B-068
B-081	B-084	C-008	C-009	C-013	C-034	C-036	C-046
C-074	C-075	D-004	D-072	F-025	F-038	H-083	K-016
K-029	K-048	M-025	M-054	M-071	M-087	N-027	O-006
P-030	P-048	R-007	R-017	S-073	S-104	T-002	T-060
W-006							

Pressure Range - 0 - 100 psi

A-009	A-015	A-085	A-095	A-134	A-186	A-212	B-053
B-056	B-090	B-130	C-023	C-042	C-054	C-060	D-056
E-021	E-029	F-004	H-076	H-079	K-003	K-042	L-010
L-046	L-048	M-032	M-044	M-067	M-107	O-005	O-006
O-007	P-001	P-014	P-043	R-034	R-055	S-012	S-016
S-033	S-053	S-063	S-107	S-116	S-132	T-009	T-010
T-028	T-041	T-049	T-057	W-068	W-081	Z-002	

Pressure Range - 0 - 5,000 psi

A-058	A-126	A-128	A-146	A-160	A-162	A-202	A-204
A-205	A-207	B-002	B-035	B-105	C-004	C-009	D-010
D-062	E-022	F-012	F-026	G-011	H-022	H-023	H-024
H-028	H-079	I-012	K-048	M-043	M-093	M-101	P-046
S-002	S-066	S-074	S-086	T-003	U-004	V-009	

Pressure Range - 0 - 10,000 psi

A-040	A-130	A-147	A-171	A-183	A-230	B-001	B-036
B-050	B-057	B-061	B-089	B-099	B-103	D-003	E-009
E-035	F-010	F-039	G-012	G-021	H-012	J-017	J-023
L-007	L-016	M-030	M-069	N-015	P-008	P-015	S-019
S-068	S-111	T-039	W-042				

APPLICATIONS, CONT'D

Pump Sealing

Packings

A-026	A-032	A-042	A-076	A-087	A-089	A-094	A-108
A-122	A-140	A-217	B-061	B-075	B-133	B-134	C-001
C-003	C-028	C-042	C-048	C-065	D-011	D-043	D-045
F-015	F-003	G-001	G-014	H-029	H-065	H-066	I-002
J-001	J-023	K-003	K-005	K-026	L-037	L-041	L-042
L-046	M-020	M-076	M-109	N-021	N-023	P-041	P-052
P-053	P-057	R-065	S-031	S-043	S-061	S-114	T-016
T-024	T-025	T-038	T-048	W-003	W-012	W-023	W-082
W-083	W-084	W-085	W-086	W-087	W-090		

Face Seals

A-094	A-123	A-140	A-217	B-059	B-102	B-107	B-130
C-001	C-018	C-038	C-048	C-054	D-001	D-012	D-015
E-021	G-001	G-007	G-011	G-034	H-066	K-005	M-022
M-083	N-024	N-025	O-007	R-012	R-013	S-021	S-027
S-033	S-039	S-047	S-084	S-133	T-003	T-016	T-024
T-042	T-043	T-048	W-059	W-087			

General

A-007	A-103	A-106	A-109	A-142	A-156	A-163	A-185
A-195	A-200	A-206	A-213	A-233	A-235	B-003	B-037
B-051	B-052	C-055	C-072	C-079	C-081	D-003	F-036
F-047	H-084	I-001	K-004	K-039	L-002	L-026	M-004
M-013	M-065	M-077	M-079	M-080	N-002	N-014	P-028
P-048	P-051	R-022	R-058	R-059	R-063	S-030	S-052
S-127	T-015	T-022	T-028	M-020	M-021	M-022	W-005
W-073							

Railway Vehicle Sealing

A-017	A-020	A-025	A-027	A-029	A-032	A-037	A-046
A-049	B-131	C-022	C-039	C-052	K-023	M-075	M-112
P-058	S-119						

Steam Engines

A-026	A-034	A-098	D-048	H-002	H-009	J-022	M-066
U-003	W-012						

Temperature Range - 0 - 2000°F

A-015	A-097	A-133	A-202	B-053	B-057	B-097	C-053
G-027	G-031	J-002	S-053	W-043			

Temperature Range - 0 - 1000°F

A-075	A-186	A-191	A-204	A-205	A-207	B-002	B-005
B-010	B-110	B-125	C-007	C-008	C-009	D-056	E-001
F-004	F-017	G-021	G-029	H-011	H-012	H-028	H-031
H-060	H-079	H-082	H-083	K-046	L-010	L-018	M-003
M-012	M-016	M-023	M-030	M-044	M-093	O-006	P-056
R-016	R-024	R-047	R-055	R-064	S-002	S-019	S-033
S-074	S-086	S-116	T-003	T-007	T-010	T-011	W-081

APPLICATIONS, CONT'D

Temperature Range - 70 to 300°F

A-093	A-135	A-184	B-010	B-050	B-056	C-029	C-040
E-029	E-034	E-035	F-026	H-079	I-011	J-002	K-048
M-013	M-032	M-058	M-101	P-003	P-046	P-047	R-024
R-034	R-053	S-012	S-033	S-066	T-042	W-025	W-037
W-054	W-081						

Temperature Range - 300 to 0°F

A-015	B-010	B-036	B-053	B-059	B-061	E-003	H-012
H-028	H-030	H-032	K-046	L-017	L-018	L-038	L-045
M-016	P-028	R-042	S-033	S-046	S-094	S-116	T-046
W-006	W-030	W-038	W-070	W-071			

Torque Converters, Fluid Couplings, Sealing

A-096	B-033	B-085	B-086	C-021	C-058	C-059	C-070
G-032	G-033	P-054	R-062	T-035			

Turbine Sealing (Steam and Gas)

A-030	A-033	A-036	A-041	A-044	A-063	A-073	A-104
A-114	A-117	A-144	A-166	A-193	A-194	A-240	B-007
B-013	B-024	B-059	B-126	C-016	C-028	C-046	C-049
C-072	D-002	D-020	E-016	F-001	F-045	G-017	G-043
H-017	H-035	J-013	J-020	K-011	L-009	M-002	M-014
M-063	M-093	N-027	O-006	P-005	P-013	P-021	P-022
P-026	P-044	P-045	R-027	R-049	R-055	S-005	S-024
S-036	S-115	S-120	S-128	S-138	T-021	T-054	V-006
W-003	W-007	W-013	W-073	Y-003			

Vacuum Sealing

A-004	A-196	A-219	A-233	B-009	B-054	B-104	B-132
C-076	D-006	D-041	D-061	E-027	F-042	F-043	F-051
H-026	H-027	H-031	H-032	H-034	J-005	J-030	J-031
K-024	K-040	M-064	M-074	M-108	N-012	N-020	R-003
R-021	R-022	R-034	R-040	R-042	R-047	R-057	R-064
S-008	S-045	S-058	S-096	S-109	T-027	T-036	T-047
T-055	U-002	V-001	W-006	W-007	W-027	W-031	W-043
Y-001							

in Face Seals

A-170	C-075	H-064	S-055	T-042	W-081

in Packings

A-058	G-009	H-054	T-021

in "O" Rings

A-013	B-015	G-010	G-013	H-030	H-036	H-058	H-064
K-002	K-051	K-052	L-043	M-017	M-090	P-040	R-032
R-041	S-041	S-072	V-002	W-001	W-061	Y-004	Y-005

in Gaskets

A-013	A-208	B-006	B-010	B-082	B-116	B-117	B-124
C-051	C-071	D-014	E-002	E-031	F-033	F-041	G-035
H-036	H-060	H-064	H-074	H-081	K-031	K-051	L-004
L-050	M-010	M-016	N-002	P-024	P-040	R-026	S-094
S-110	S-113	W-063	Y-002				

APPLICATIONS, CONT'D

Valve Sealing

A-012	A-017	A-026	A-027	A-028	A-067	A-074	A-090
A-122	A-125	A-163	A-232	B-006	B-035	B-039	B-051
B-071	B-119	C-003	C-020	C-028	C-052	C-055	C-057
C-060	C-072	C-078	C-081	D-011	E-029	E-036	F-007
H-002	H-021	J-001	K-016	K-024	K-051	L-050	M-004
M-017	M-021	M-050	M-093	M-106	M-112	N-011	P-058
R-043	S-005	S-006	S-030	S-045	S-134	S-137	T-022
T-027	T-055	U-002	V-002	W-080	Y-001		